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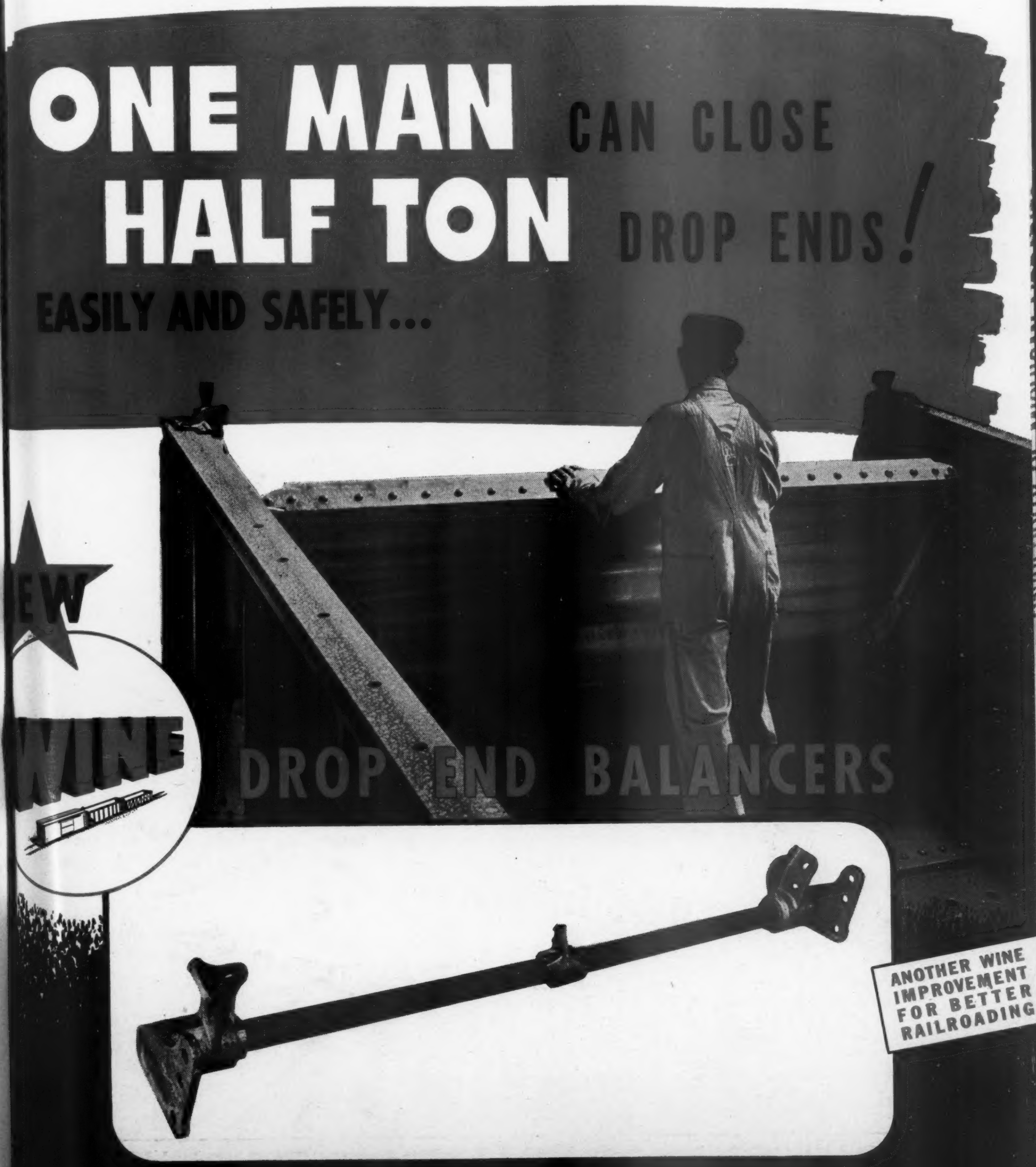
May
1946



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RAILWAY
MECHANICAL ENGINEER

A Look at

Locomotives of Tomorrow*

By Charles Kerr, Jr.†

Author appraises some probabilities affecting the prospects of reciprocating steam, geared-steam-turbine, steam-turbine-electric, Diesel-electric, gas-turbine and electric locomotives

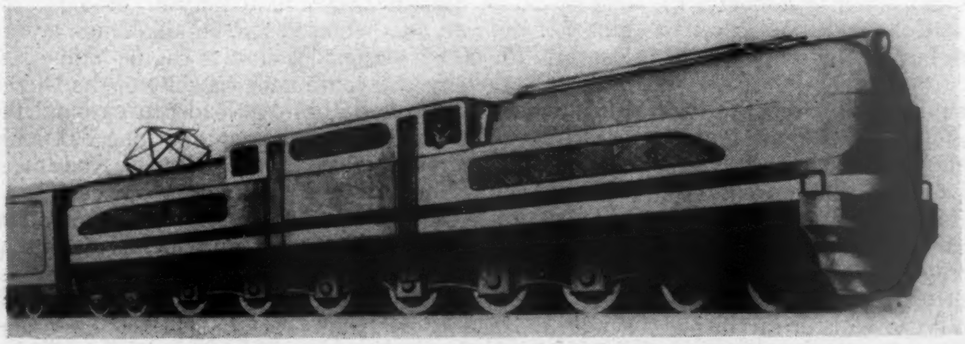
TODAY the railroads are generally operated by three classes of motive power—reciprocating steam, Diesel-electric and electric. But new types are rapidly coming into use. In 1944, the geared steam turbine made its appearance and promises to open new fields for steam power. Soon the first coal burning steam turbine electric will enter service. And, in the not too distant future, the gas turbine locomotive is certain to appear. With the diversity of operating conditions encountered by the American railroads, there are places where each of these types can be put to good use, and none should be "sold short."

Electrification

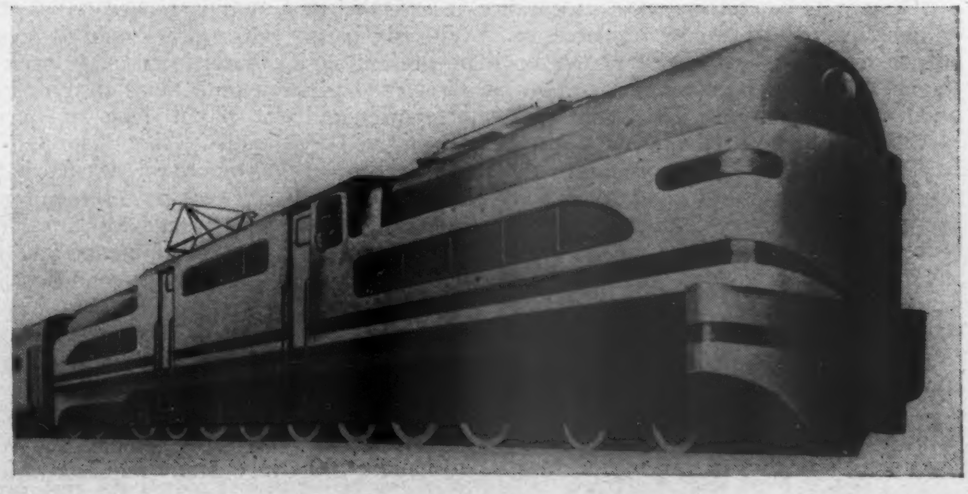
Unfortunately, because of a rather high first cost, electrification has been confined in its application to lines of heavy traffic density, or to the solution of operating problems which, by other means, could not be overcome. However, in spite of this handicap, certain trends are appearing which are likely to produce an extended use.

First—the railroads must continually improve their service to prevent their competitors obtaining a large share of the nation's traffic. To meet this competition and keep the traffic on the rails where it belongs, passenger trains will eventually operate at 100 m.p.h. or more, and freight trains at 70 m.p.h. or more. To maintain such speeds continuously, locomotive capacities will exceed those generally in use today. Operation of heavy

* Abstract of a paper presented before the New York Railroad Club in New York, N. Y., March 21, 1946.
† Consulting Transportation Engineer, Westinghouse Electric Corporation.



An electric locomotive with a continuous rating of 7,500 hp.



A 10,000 hp. (continuous rating) electric locomotive with a 2-D-D-2 wheel arrangement

traffic under these conditions enhances the economies to be derived from electrification and broadens its scope of economical application.

Second—the direct operating expenses of an electrified railroad are the absolute minimum. With inflation facing us, this feature of electrified operation will become increasingly attractive.

Third—with the continued increase in efficiency of centralized power generation, the trend of electric power costs has been downward while all other fuels are steadily increasing in price. Electricity is produced by burning coal or by water power, our most assured long range sources of energy. This assured abundance of low cost electric power may have a marked future influence on the selection of railroad motive power.

If the first cost is to be reduced, there must be greater standardization. In addition, it should be made easier for a railroad to electrify. Any railroad should be able to purchase an electrification, completely engineered and installed, for a definite price, accompanied by a long term power contract and a simple plan of financing. Electrification should be just as easy to buy as any other type of motive power.

To show what may be accomplished by electrification, I would like to present two locomotives which are typical of the electric locomotive of tomorrow.

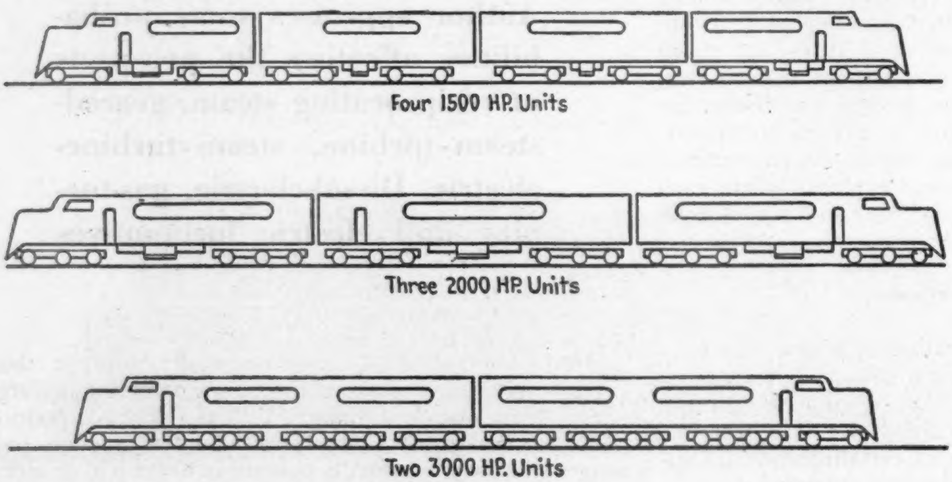
The first of these locomotives has the conventional 4-6-6-4 wheel arrangement. This cab and general wheel arrangement make the best operating unit known to the locomotive art. In fact, all locomotives, steam and Diesel as well, would probably be built to the same general arrangement if it were possible to do so without sacrificing other essential characteristics.

Despite its familiar outward appearance, it nevertheless differs inwardly from its predecessors. With six pairs of drivers, it is physically no larger than present designs and only slightly heavier. But it carries 50 per cent more capacity, or 7,500 continuous horsepower and 13,000 maximum horsepower.

The second design is similar to the first one shown, except it has eight driving axles. Without exceeding generally acceptable dimensions and weights, 10,000 continuous horsepower can be developed, or 17,000 maximum horsepower.

Both locomotives can meet practically any desired combination of speed and axle loading. They can be built to operate on either d.c. or a.c. systems and production could be started on short notice.

They have sufficient power to handle heavy passenger trains, 15 to 20 cars, at speeds of 100 to 125 m.p.h., over long stretches of varying profiles, or to handle 100 to 125-car freight trains at 70 to 75 m.p.h. under similar conditions. They will meet any foreseeable future requirement. Furthermore, there are no other types in prospect, at least for many years to come, capable of meeting the performance of these locomotives.



Diesel locomotives for high-speed passenger service

The Diesel-Electric

The Diesel-electric has characteristics which make it especially well suited to switching, transfer and branch line service, where, as a general rule, units of 2,000 hp. or less are required. Road service demands big locomotives. The largest Diesel road locomotive develops 6,000 engine horsepower. When the losses between engine and rail are deducted, the net horsepower available is approximately 5,000. As now constructed, these locomotives comprise 2, 3, or 4 units totaling approximately 200 ft. in length, and weigh between 185 and 230 lb. per rail horsepower.

Of the various single units now manufactured, the largest delivers about 2,500 hp. at the rail, or 3,000 engine horsepower. By comparison, in the same overall length, a 10,000 hp. electric locomotive can be built—just four times the effective continuous capacity of the Diesel. Furthermore, this electric has overload capacity and the Diesel does not. Steam power is approaching 8,000 hp. or almost three times that of the Diesel. And there will apparently be demands for still larger power.

To appraise completely the Diesel road locomotive, it is interesting to examine the requirements of present designs when handling large trains at various speeds. At 80 m.p.h., two conventional cabs are sufficient to handle modern 17-car trains weighing 1,150 tons, and at 100 m.p.h., three cabs are ample. At these speeds, the motive power is within present standard practices. However, should passenger speeds exceed 100 m.p.h., the Diesel locomotive, as it exists today, might rapidly become a monstrosity. For at 125 m.p.h., the locomotive is 370 ft. long and weighs 80 per cent of the train it hauls. About one-half of the power developed by the locomotive is wasted in pulling itself.

These power requirements provide no margin for adverse grades, or for rapid acceleration to these speeds. The requirements have not been exaggerated.

A similar condition will exist in high-speed freight service. To operate a 5,000-ton train at 70 m.p.h. requires almost three times as much locomotive capacity as that required at 40 m.p.h. The locomotive becomes a fair sized train in itself.

Admittedly, few trains are operating at these extremely high speeds today, but we feel confident that they are coming. Many requests which we are now receiving for new

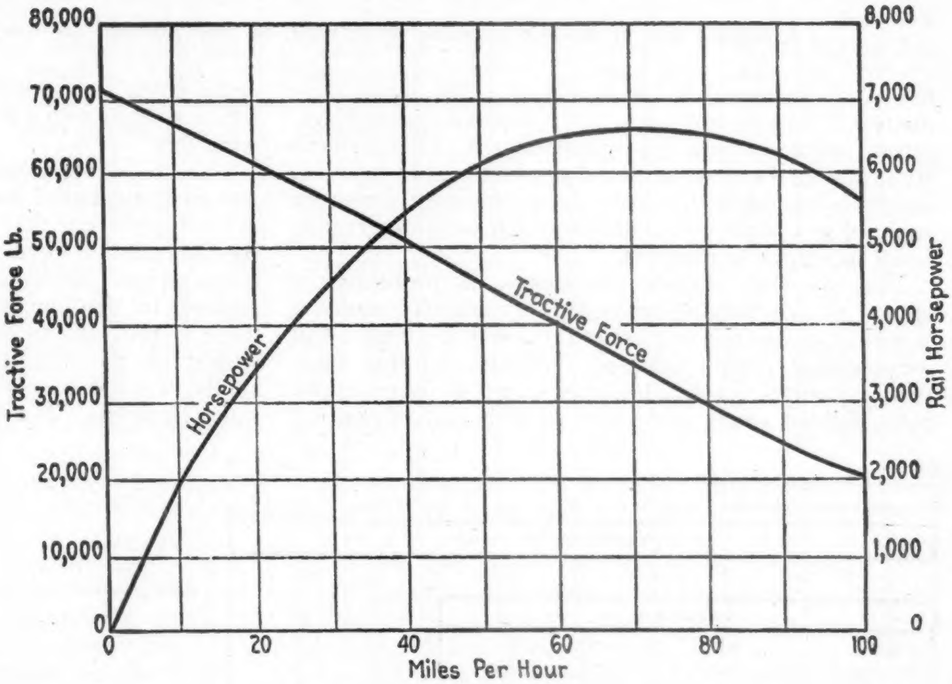
locomotives demand provision for future operation at such speeds, indicating that railroad managements are anticipating them.

The limitations of the Diesel locomotive are often accredited to the electric transmission, and by the same token, it is claimed that everything would be all right if it could be avoided. I wish to take exception to this thinking. By the electric transmission, and nothing else, the Diesel engine has been converted into a satisfactory prime mover for railroad service. Actually, the Diesel engine has very poor characteristics for traction purposes. Furthermore, electric transmission has provided a very flexible means for delivering power to the rail, and has permitted the prime mover to be designed with the greatest freedom from many burdensome restrictions.

The long range status of the Diesel locomotive would be bettered if greater capacity could be built into a single unit. Physically, the largest single-unit locomotive which can operate within the clearance restrictions of most roads is about 92 ft. long, employing twelve carrying axles, any number of which can be made into driving axles.

With motors that are now in large scale production, only eight driving axles are needed to give ample starting and continuous tractive force for most passenger service. But, the speed at which this locomotive will operate with its load is entirely a function of the power plant capacity; that is, the Diesel engine itself. The largest engine capacity yet placed in this size cab is 3,000 hp. Electrical equipment now available can utilize 6,000 hp., but the Diesel engines to produce 6,000 hp. in this space are yet to be produced.

With this same running gear, and the same motors, a freight locomotive could be built with all 12 axles motorized, providing 180,000 lb. starting tractive force and 125,000 lb. continuous tractive force. Actually, these 12 motors could absorb 9,000 Diesel engine horsepower if the Diesel engines were available to deliver this amount of power.

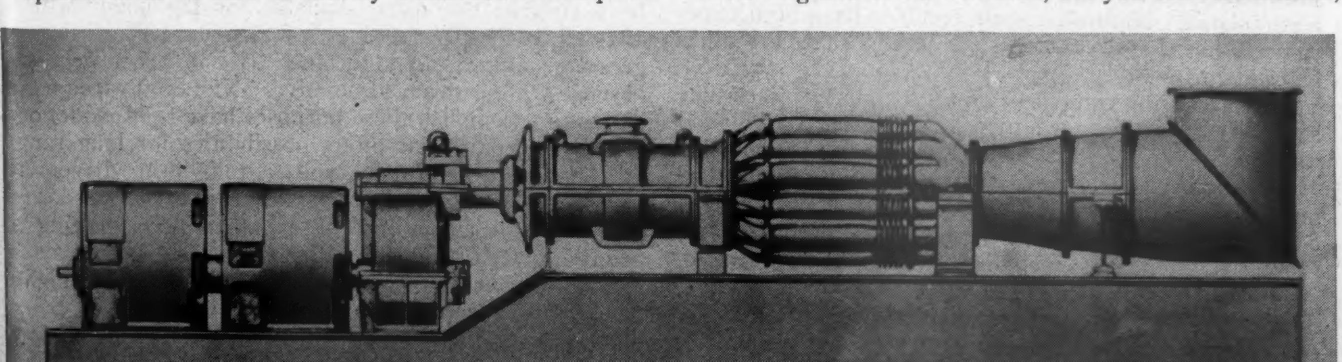


Performance characteristics of the Pennsylvania Class S-2 geared turbine locomotive

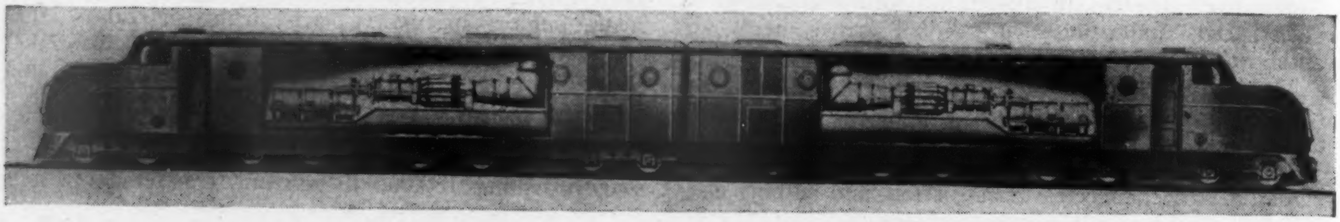
Our many years of experience in building locomotives and of association with the railroad industry leads us to believe that eventually the most serious limitation of the present Diesel locomotive will prove to be its relatively poor weight and space efficiency. We want to see these improved, for then the future of the Diesel will be even brighter, with its field of application ranging, without undue restrictions, from the smaller sizes suitable to switching service to the largest main line requirements of the future. We believe this is the most important development needed in the Diesel field.

Steam Locomotives

Today, steam is encountering the toughest competition of its long and useful existence, but you can rest assured,



A 2,000-hp. gas turbine with geared drive and electric generators—The unit is 26 ft. 3 in. long, 3½ ft. wide and 6 ft. high



A proposed type of two-unit locomotive which might use four 2,000-hp. gas turbines for freight service

the old "iron horse" is far from dead. The steam locomotive is rapidly becoming three locomotives—reciprocating, geared-turbine and turbine-electric. The modern reciprocating locomotive is the product of 125 years of constant development. New developments are usually confined to a perfection of details which, in the aggregate, result in extensive progress.

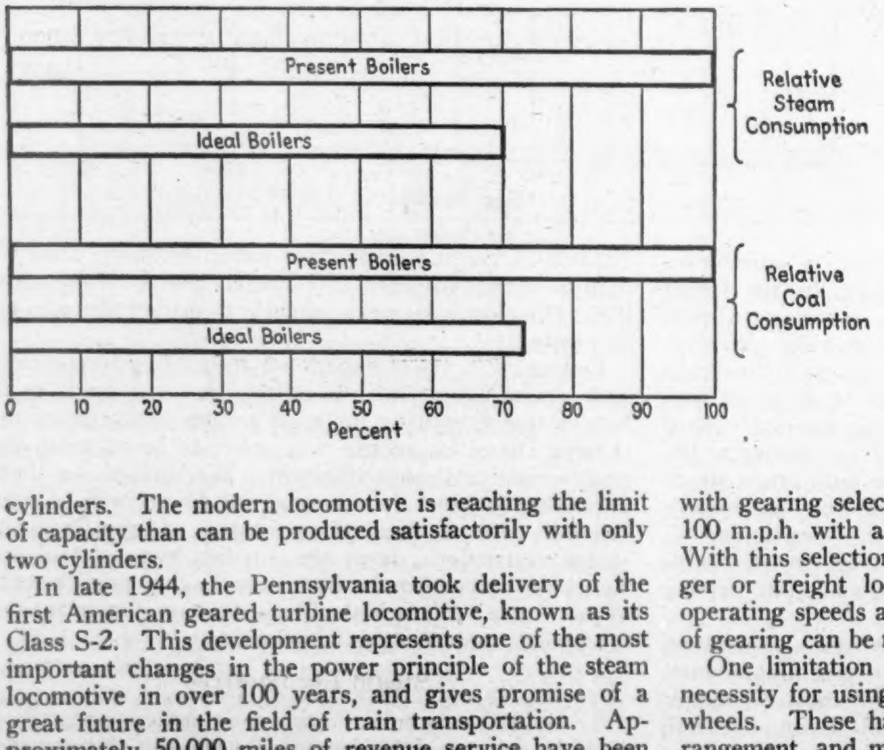
The so-called "duplex" locomotive is probably the answer to reciprocating drives for very large locomotives. Where increased power must be produced, the trend in all reciprocating engine practice, including internal combustion engines, is towards higher speeds of reciprocating parts, lighter weight parts and an increased number of cylinders. The modern locomotive is reaching the limit of capacity than can be produced satisfactorily with only two cylinders.

In late 1944, the Pennsylvania took delivery of the first American geared turbine locomotive, known as its Class S-2. This development represents one of the most important changes in the power principle of the steam locomotive in over 100 years, and gives promise of a great future in the field of train transportation. Approximately 50,000 miles of revenue service have been accumulated. Naturally, some troubles have been experienced, but they have been less serious than any of us had anticipated.

The propulsion equipment on the Pennsylvania turbine locomotive was designed to follow proven marine and rail practices to the greatest possible extent. The weights of the actual turbine and drive are quite interesting. The main turbine, producing 6,900 shaft horsepower, weighs 5,000 lb., or less than ¾ lb. per horsepower. The entire propulsion apparatus, including auxiliaries and control, runs less than 6 lb. per horsepower. To our knowledge, these are the lowest weights ever attained in propulsion equipment for traction purposes.

The locomotive was built during the war period. Alloy steels were prohibited in the main frames or boiler. To avoid a decrease in capacity, the 6-8-6 wheel arrangement was selected. Under normal conditions the locomotive would have been constructed with a 4-8-4 wheel arrangement, and most certainly all future locomotives will be so built with a decided reduction in total locomotive weight.

One of our big surprises when the turbine locomotive was first announced was the discovery that many people did not appreciate that a turbine could produce sufficient starting tractive force for train operation. Actually, the characteristic performance of a geared turbine is well adapted to traction purposes. Ample starting tractive force is provided to utilize fully the available adhesive weight on the driving axles, to which is coupled an ability to maintain a high horsepower output over a wide range in speeds. The Pennsylvania locomotive was built with gearing selected for maximum operating speeds of 100 m.p.h. with a 10 per cent margin for overspeeding. With this selection of gearing, it is a high-speed passenger or freight locomotive. Where the predominating operating speeds are higher or lower, a suitable selection of gearing can be made.



Relative steam and coal rates per drawbar horsepower-hour for non-condensing steam-turbine locomotives

One limitation of the steam locomotive has been the necessity for using side rods and large diameter driving wheels. These have limited the selection of wheel arrangement, and most important of all, the large wheels have reduced the space available for the boiler which, after all, is the ultimate limit of capacity. Work is progressing on a geared turbine drive to remove these obstacles to the steam locomotive. Numerous designs of drives to accomplish these purposes have been made, one of which in particular offers possibilities for long range development. This drive will permit 48-in. drivers to be used, irrespective of the maximum speed desired, and will substitute a longitudinal shaft and bevel gearing to take the place of the side rods. A reverse gear may be incorporated in the high-speed gear reduction to eliminate the reverse turbine. Furthermore, with the proposed type of reverse gear, a different gear ratio can be provided, if desired, in the two directions of operation. Before a drive without side rods can be successfully used, one of the fundamental problems to be solved is the determination of the division of load between driving wheels when all wheels may not be of exactly equal

diameters. As no information existed on this subject, we made extensive tests on one-fifth scale models to get the answer which was both interesting and encouraging.

A geared turbine drive of this character would permit radically new types of steam power to be built. For example, there is a design developed by the Pennsylvania Railroad, employing the geared-turbine drive which we have described, in which the truck type of running gear becomes available in steam practice, introducing a type of locomotive which has proven so eminently satisfactory in electric and Diesel electric practice. Thus, excellent tracking characteristics are assured. In addition, restrictions are removed to the firebox, grate and ash pan. This locomotive, developing 9,000 hp., would be driven by two turbines, one on each truck.

Another application might be to the conventional 4-8-4 type, in which the wheels are small and the rigid wheel base is shortened. The turbine is located under the smoke box, simplifying the steam piping. The short rigid wheel base provides space for a larger grate and fire box, increasing the efficiency of burning fuel. The small wheels afford space for a larger diameter boiler, reducing the draft loss. These factors indicate better locomotive operating characteristics and better overall efficiency.

A third application of this drive is an attempt to provide the ideal universal freight and passenger locomotive. With small wheels, six driving axles can be introduced into the same overall wheel base now taken by fewer axles. The tender has also been redesigned to be either pushed or pulled, employing an arrangement of wheels to permit this kind of operation. The reverse gear provides a different gear ratio in the two directions of motion. Running with the locomotive forward, the locomotive would be a 120 m.p.h. passenger unit; with the tender forward, a 70 m.p.h. freight unit, providing improved characteristics in the speed range common to freight service. With six driving axles, sufficient boiler capacity can be carried to develop 8,000 to 9,000 hp. without excessive wheel loads.

Before leaving the geared turbine drive, I would like to introduce one other future possibility—a gear shift. Before you throw up your hands at such a radical introduction to locomotive practice, remember that turbines operate at speeds which have never before been used. Designs of a gear shift have been made, and the equipment for a large locomotive is about the size of a bushel basket. The gear shift makes possible a locomotive with a maximum tractive force of 140,000 lb., capable of developing over 7,500 hp. at all speeds from 20 to 100 m.p.h., and with essentially a constant steam rate over this whole speed range. A single locomotive becomes suitable for any type of rail service, drag freight, high speed freight, or passenger.

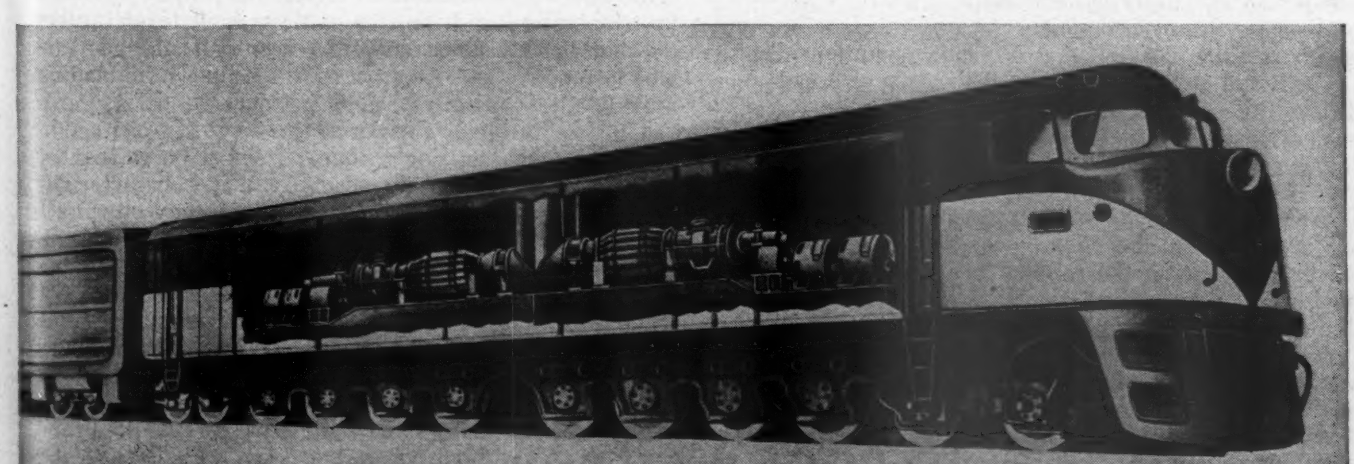
The exact line of demarcation where electrical or mechanical drive for a turbine locomotive becomes the preferred transmission has not been fully determined. Electric transmissions have a background of millions of miles of service, and new installations and new materials are continually producing equipments with better space and weight characteristics. They also provide certain flexibility in the overall arrangement of the locomotive that a mechanical drive cannot obtain for electric transmission permits the prime mover to be completely disassociated from the driving wheels.

In a few months, the first coal burning, turbine-electric locomotives will enter service on the Chesapeake & Ohio, introducing another new type of steam motive power. While these locomotives will be equipped with conventional boilers, they will be quite novel in many respects. A cab mounted 6,000-hp., 6,000-r.p.m. turbine will drive two direct-current generators through single reduction gearing. Traction power will be derived from eight axle-hung motors. The locomotive speed will be controlled by a variation of turbine speed and generator excitation, the combination which produces the best overall efficiency.

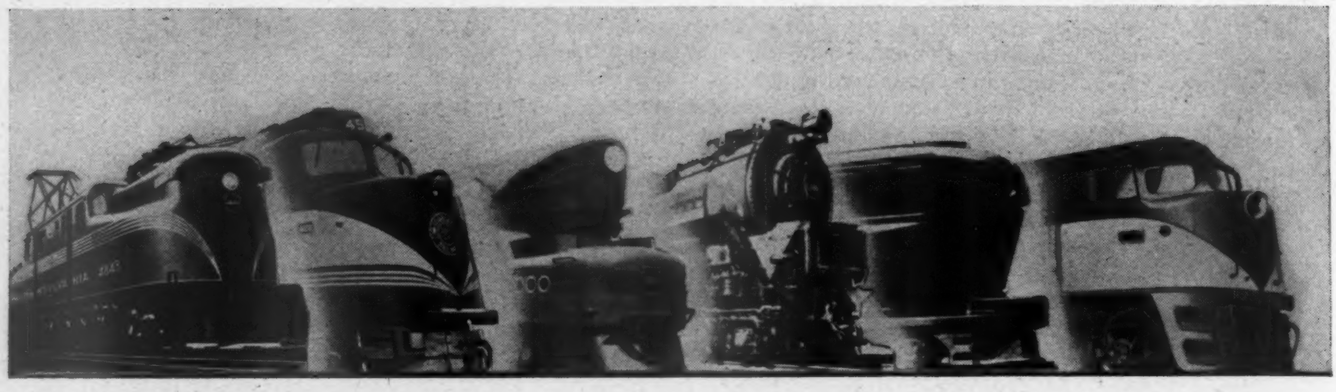
These locomotives are being built for passenger service between Washington and Cincinnati, a territory where long severe grades are encountered in some portions, and where fast speeds are demanded in others.

The application of electric transmissions to a turbine locomotive involve certain considerations that are different from those in Diesel practice. The turbine operates at 6 to 20 times Diesel engine speeds, has high standstill torque, will not stall if overloaded, and within reasonable limits, its horsepower is constant over a wide speed range. With these characteristics, alternating-current types of electrical transmission offer possibilities worth consideration; and this the a.c. systems are receiving. The first turbine electric locomotives will use the d.c. drive as it is a proven device. Further development may make the a.c. types competitive in weight, cost and performance.

The steam locomotive needs a better boiler. The best modern steam locomotives with fire tube boilers operate at approximately 300 lb. pressure, 750 deg. F. total steam temperature and 15 lb. exhaust pressure at full load. When operated at capacity, boiler efficiencies are about 50 per cent. Central station and marine apparatus operate under considerably more favorable steam conditions. Were the steam locomotive to operate under equally favorable steam conditions, it would be a motive power unit with low fuel expense.



Gas turbines might be used in the manner shown to produce an 8,000-hp. passenger locomotive



Electric, Diesel, steam, turbine, turbine-electric and gas-turbine-electrics—The first four are in service, the fifth under construction and the sixth contemplated

The advent of the turbine drive will accelerate the development of better boilers for it provides a means fully to utilize high pressures, high temperatures and low exhaust pressures. The steam conditions for the ideal non-condensing 6,000-hp. turbine locomotive are 600 to 800 lb. pressure, 900 to 925 deg. F. total steam temperature and 0 to 5 lb. exhaust pressure. To produce such low exhaust pressures may require auxiliary means for drafting the boiler.

Compared with the best modern practice, the steam consumption per horsepower hour would be reduced about 30 per cent. The fuel consumption would be reduced about 27 per cent, assuming the same boiler efficiency. Better steam conditions pay large dividends.

The burning of pulverized coal has many advantages and considerable work is under way to find means of using it in locomotive boilers. This is not, however, a simple problem. But sooner or later, it will be solved, for the burning of pulverized coal, both in a boiler and eventually in the gas turbine, is of such importance that the time and money will be forthcoming to perfect a method.

While steam power is meeting the most severe competition that it has ever known, the steam locomotive enjoys five attributes that will continue to be a thorn in the side of its competitors:

1—Low first cost. With production in equal volume, this advantage will also be enjoyed by the turbine.

2—Modern steam power, with modern maintenance methods, is making available availability records with exceedingly low repair costs.

3—As a means of packing power into a single locomotive unit, steam power, reciprocating or turbine, leads the parade except for electrification.

4—The steam locomotive, reciprocating or turbine, can burn either coal or oil as economic conditions dictate.

5—Better steam locomotives than we have ever known before are on their way.

The Gas Turbine Locomotive

The gas turbine operates on hot air, and if all the "hot air" expended in the public press about the gas turbine could be collected, the railroads would have a cost-free fuel for all time. The gas turbine has great possibilities, but it is not necessarily a cure-all.

The principle of the gas turbine has been known since antiquity. The fundamental theory was well developed in the late 1800's. You may well ask, "Why has it not been used before?" The answer is a simple one—Materials have not been available to withstand the required temperatures. At 800 deg. F., the gas turbine will just turn itself over. Useful work is performed only to the degree that temperatures above 800 deg. F. are employed.

There is a 2,000-hp. gas turbine generator unit, now on test, suitable for locomotive use. The entire unit is 26 ft. 3 in. long, 3½ ft. wide and 6 ft. high. Two units might be placed side by side in a locomotive with a center aisle, permitting 4,000-hp. of prime mover capacity in approximately 26 ft. of cab length. This unit is designed to burn bunker C oil. It consists of a compressor, combustor, turbine, gear unit and generators. Its overall weight is 39,000 lb.

To my knowledge, this is the first American gas turbine designed and built with dimensions suitable for application to locomotives of large capacity. It is now on the test floor, getting the "bugs" worked out of it.

This unit is the gas turbine in its simplest form. In stationary practice, heat exchangers, regenerators, intercoolers, pre-heaters and a host of other gadgets might be added to improve efficiency where space and weight are not controlling items. We believe the railroads prefer greater power within the same space at a slight sacrifice in efficiency. By burning a cheaper grade of fuel with a somewhat reduced efficiency, the gas turbine's fuel cost will be competitive with the Diesel.

In the gas turbine, the products of combustion are used directly in the turbine which operates at temperatures above 1,300 deg. F. Complete fuel combustion must be obtained in the burners, for a carryover of liquid or solid matter will erode the blades at these high temperatures. Aviation fuels cannot be used on locomotives, either from the cost or safety viewpoint. The first railroad gas turbines are likely to burn some grade of fuel oil such as Bunker C.

The second big problem is blading material to withstand the high temperatures. Material is affected both by temperature and life, for at these high temperatures the material has a tendency to "creep." If the gas turbine locomotive is to be successful, the life of the blading must be measured in years, not in hours.

The gas turbine, when used to drive its own compressor, has no starting torque. It must be started by auxiliary means like the Diesel. This characteristic compels the use of electric transmission, or two turbines, one for traction. The first gas-turbine locomotives will unquestionably use the d.c. system of transmission because it is a proven device and plenty of headaches exist without looking for additional ones. Eventually some form of a.c. drive may prove practical with the gas turbine, especially the rectifier conversion system.

Steam turbines have been perfected to the point where they operate for many years without repairs. Often they run for years without being shut down. Eventually, the gas turbine should approach this same service life, pro-

(*Continued on page 256*)

E.T.O. Army Transportation*

By Col. E. C. Ringberg†

Shop battalion commander tells of the Transportation Corps' accomplishments in the European Theatre of Operations and the part "Ringberg's Raiders" had in arriving at "Destination Berlin"

Lt. A. E. Eggers, T/3 George Liverar and T/5 Willard Longacre installing air compressor on an M.R.S. locomotive

THE story of the Transportation Corps of the U. S. Army in World War II is one of long and arduous hours of "soldier-railroader" train and engine crews working and struggling under the most difficult conditions—frequently running a trainload of ammunition, supplies or troops from the rear area to the front, through bombing and aircraft strafing raids, through unexplored tunnels for the first time, sometimes to find their complete train surrounded by the enemies' rapid infiltration action and being left to sweat out the remainder of the war in some German prison camp. It is the drama of the truck and convoy driver, weary from working under the same conditions, driving through pitch blackness. It is the story of the stevedores sweating out long hours unloading and loading valuable cargoes from ships, and the amphibious truck driver ferrying cargoes and troops from ship to shore through mine infested waters.

Last but not least, there is the almost forgotten man in the enginehouses and back shops whose day was never done and when an emergency arose, who with improvised tools and equipment and lack of adequate shop facilities maintained rolling stock up to the best standards that could be expected under such conditions. Let me say here that the best thing the War Department ever did in formulating the table of organization for military railway operating and shop battalions was to omit the Interstate Commerce Commission inspector. The book was actually thrown out the window. Running repairs were made within safe operating limitations as far as time and materials would permit and it was a revelation for me to see how far a locomotive could steam and run with mud in a boiler that hadn't been washed out for three or four months and tires and running gear worn far beyond any condemning limits recognized in this country. The story of the Transportation Corps can go on and on with glorious chapters for the railroad dispatcher who often had to dispatch trains by bicycle or jeep, the tug boat crews, the switchman, the section hands and the busy railroad transportation officer (the station agent) who in addition to his many duties was confronted with the problem of trying to do business with an Italian, a Frenchman, Belgian or German who knew not the English language, nor did the RTO know how to talk or understand him. The situation, however, was usually facilitated by employing the services of an interpreter and the arrangement worked out quite satisfactorily, but many amusing incidents arose.

Normandy Beachhead

The miracle in transportation occurred on D day, June 6, 1944. Toward the beaches of France moved a mass of seacraft of all types carrying trucks of every description and, as the invasion advanced, enough railroad equipment to run any Class I railroad in America. The Transportation Corps does not claim all the credit that went with this tremendous achievement. Nevertheless, the brunt of the burden of transporting in coordination with the navies the thousands of troops, tanks and war equipment and materials of all descriptions to the beaches of Normandy fell on the Transportation Corps. The assignment of the Transportation Corps prior to D day fell basically into three categories, namely: (1) The movement and unloading of men and materials to the United Kingdom; (2) the movement of men and materials within the United Kingdom (The English railways, however, were functioning quite satisfactorily even under the severe punishment handed out by German bombings and the English aided greatly in this phase); and (3) the movement and loading of men and supplies out of the United Kingdom to the Normandy beachheads and the hazardous unloading under fire. The outcome is now glorious history. Before the beachheads closed, the Transportation Corps had landed 1,991,013 tons of supplies and more than a million troops.

*This article is adapted from a paper presented before a meeting of the New England Railroad Club at Boston, Mass., on March 12.
†Formerly Commanding Officer, 764th Shop Battalion, M.R.S.

After the beachheads were secured, the Transportation Corps was confronted with another major problem. The Germans reasoned that if our supply lines could be broken, our forces would be subjected to successful counter attack by them and so they hung onto the ports of Le Havre, Brest, Cherbourg and others to the bitter end, always harassing and threatening the Transportation Corps' efforts to get the supplies through the front. Through days of anxiety, the port of Cherbourg was first to fall. Here again the soldier-railroaders of the port battalions and the harbor craft of the Transportation Corps proved their worth. It took months before the port of Cherbourg could be used to advantage and until then all unloading was still restricted to the difficult Normandy beachheads. Cherbourg harbor had to be de-mined, land mines had to be removed, and ruined dock facilities had to be restored. The port itself in peacetime was used primarily for passenger traffic rather than heavy cargoes and this added to the difficulties. For three days one of the severest channel storms for years arose and did much damage to causeways and shipping and when the storm was over the port was almost in as bad a condition as it was when the Germans surrendered.

Supplying Mechanized Forces

With the subsequent fall of Le Havre, Brest, Rouen and other channel ports, the task of unloading for the Transportation Corps became easier, but by no means was this to be a let-down. The fast advancing motorized American Army had to have its gasoline and oil as well as supplies and equipment and the next big challenge to the Transportation Corps came when General Patton of the Third Army depended entirely upon the Transportation Corps in this requirement or else had to hold up his advances. This was no idle gesture on the part of General Patton, in fact, he was held up temporarily because gasoline could not keep up with him. However, the Transportation Corps pressed into service every available conveyance on wheels that could haul gasoline and oil, either in cans or bulk, and it was then that the Transportation Corps answered that challenge and finally satisfied that demand; never before at any one time had such large quantities of petroleum products been handled.

The burden fell largely on the Army trucks which had greater flexibility than the railroads in delivering to the advanced positions. The railroads hauled as much as they could and as far as they could go, and every gallon of gasoline helped. If the trucks used in this spectacular movement had been placed end to end they would have reached from Cherbourg to Paris, a distance of over 250 miles. The daily commitment of gasoline and oil at that time was raised from 300,000 to 600,000 gallons to satisfy both General Patton and General Hodges of the First Army, who also was desperately in need of gas and oil.

The famous "Red Ball" truck express was inaugurated at this time, primarily for the hauling of gas, oil and lubricants. Its slogan was, "Stay on the ball, keep 'em rolling." Main highways giving the most direct route to destination were reserved for this traffic only, marked by a red ball and arrow for guidance at all intersections and at frequent intermediate points, and traffic moved only in one direction. The "Red Ball" express was a complete success for the purpose intended, another case of real American ingenuity.

While all this was going on, the Corps was busy clearing the port of Le Havre, destroyed beyond anybody's imagination, and later took up operations in Antwerp, known as the "City of the Purple Heart," captured almost intact, but subjected to a V-1 and V-2 bomb seige that was almost unbearable. In the face of all this, the Transportation Corps handled 3,426,046 tons of supplies from November, 1944, to June, 1945. The city of Leige, Belgium, also went through a similar buzz-bomb seige intensified by aerial bombings and strafing, but the railway operating battalions kept the trains moving. During the "bulge" action in Belgium, December, 1944, my battalion was working around the clock in Paris, maintaining hospital trains, locomotives and cars. The Germans vowed after leaving Paris that they would return by New Years (1945) and every Frenchman believed it and the threat grew day by day. Before I knew it, I had enough TNT given me to blow up every locomotive and car in the vicinity and was given special instructions on demolition. Fortunately, our armies held and we had no occasion to use it. A sneak bombing raid was pulled by the Germans at that time on my installation at St. Lazare station and the Dutchman had one strike on me. We had 25 casualties that night and God's grace prevented us from having more.

Locomotive repairs being made by T/5 Updike, S/Sgt. Mason, T/3 Doak, Pfc. Wright, S/Sgt. Anderson, and T/5 Thompson

Left to right: Pvt. Howes, Pvt. Nuney, T/Sgt. Janos and T/4 Daw at the Clichy coach shop, Paris

"Ringberg's Raiders"

I have outlined, generally the highlight activities of the various branches of the Transportation Corps. You may be interested in a few highlights in the training and the work of the 764th Military Railway Shop Battalion (better known as "Ringberg's Raiders"). Even though the enlisted personnel of this battalion came from all parts of the United States, it still belongs to the New England railroads and the railroads of New England will have an honorable place in history because of it. The battalion was sponsored by the Boston & Maine, Delaware & Hudson, and Central Vermont, these railroads agreeing to release a group of 23 officers for the duration and the opportunity went to railroad shop supervisors willing to volunteer, subject to release by the railroads.

The enlisted personnel, approximately 600 men, came from the selective service. Men of railroad experience were given priority but only about 15 per cent were available. The balance, those who had any prior occupation at all before the war, ranged from bakers to musicians. This was the makeup of my battalion when I, with my staff of officers, took over at New Orleans, La., in September, 1943. We had the same task confronting us as any railroad shop, car shop or rip track had in this country. However, the training given these non-railroad men before going overseas was unique and today many of them can qualify to hold down a good shop mechanic's rating.

Training Shop Battalions

Being a part of the Army and a military organization, the battalion was first streamlined along military lines and thus we became soldier-railroaders with enough military training to enter combat if necessary. Every man was equipped with and qualified to shoot the carbine and qualified as well to shoot the M-1 Garand rifle and the Browning automatic rifle. We crawled through barbed wire and mud-holes and exploding TNT, simulating shell fire, with live machine-gun bullets whizzing only a foot above our heads (the idea was to keep your head down). In fact, we received all the training given to an infantry soldier, only on a modified scale.

Satisfied that our basic military training was sufficient, the battalion was then sent from New Orleans, La., to Bucyrus, Ohio, for technical training, but here again emphasis was placed on the military aspect and for seven months our training was divided into 50 per cent military and 50 per cent technical. The technical training was outstanding and it was here that the non-railroad men received fundamental experience in various shop crafts. Through the War Department's negotiations with the Pennsylvania and the Baltimore & Ohio our men worked side by side with experienced railroad employees in the enginehouses and rip tracks at Crestline, Ohio, eight miles from Bucyrus by bus, and at Willard, Ohio, 35 miles from Bucyrus, also by bus. A specialized training arrangement was also set up by the Army at Mansfield, Ohio, where the essentials of sheet-metal work, piping, electricity and welding were taught. The old abandoned New York Central shop and rip track in Bucyrus was another shop taken over where old engines and cars were used as guinea pigs to give the men practical repair experience.

The Railway Operating Battalions were likewise technically trained on the Claiborne & Polk Railroad in southern Louisiana, known to the military railways as "Old Crime and Punishment." It was the "screwiest" railroad ever known, as crooked as could be made, where roadbeds and trains were deliberately blown to pieces to be rebuilt and put back into operation as quickly as possible just for the sake of training. At the same time, too, the battalions had to go through an intensified military program.

Overseas Assignments

Our training completed, the battalion was ready for overseas duty as soldier-railroaders, to participate in the big adventure and our first mission was given to us in South Wales. Steam locomotives, types 2-8-0 and 0-6-0, and complete Diesel locomotives, 350 hp., 650 hp. and 1,000 hp., sent to England from the United States long before D day, were rusting away on railroad sidings and yards in southern Wales. Consequently, before this equipment could be used on the continent it had to be reserviced, lubricaated, test operated and finally loaded on seatrains designed especially for water shipment of railroad rolling stock and the task fell to my battalion. Three gauges of water were put into the boilers of the locomotives before loading, wood and paper was placed in the fireboxes ready for the match upon arrival on the continent and enough water was placed in the tenders to keep them moving. It was no easy assignment for a group of men with the small amount of experience we had, but we

did it and felt that we were really aiding actively in the war effort.

Advance parties from the operating battalions had already prepared the tracks at Cherbourg and inland immediately after its fall. Full trains were made up and the supplies went forward without delay. One mishap, however, occurred during the unloading operations at Cherbourg. With a 2-8-0 locomotive hanging perilously at the end of the boom on a sea train, the boom snapped and the engine fell into the harbor and until the boom was repaired, the movement of locomotives to the continent was retarded for some time. Box cars, flats, gondolas and caboose cars received in England from the United States in sections to save cargo space during the ocean crossing, were assembled in car shops throughout England and shipped over to the continent ready to go. Later on, car assembly shops were set up in Marseilles, France, and as many as 150 box cars were assembled at these shops in a 10-hr. day.

The real challenge to the battalion came at Le Mans, our first assignment in France. Here, before the war, was a complete French railway terminal with up-to-date concrete enginehouses, back shops, coal pockets, machinery, etc. When we arrived on the heels of the German's evacuation it was a panorama of rubble and ruin beyond anybody's comprehension. What our bombings hadn't destroyed, the Germans finished with demolition and sabotage.

Our mission was to get the terminal functioning without delay and at first sight the task looked impossible. Nevertheless, within a week, working around the clock in darkness at night, employing civilian labor and prisoners of war, with only a meager amount of small tools and machinery, without power and lights, air and other necessities required to run an enginehouse and back shop, we were dispatching locomotives. It was a case of improvising tools and machinery, stealing from nearby shops and searching the countryside as far away as 100 miles to find an abandoned German air compressor, a portable power plant or a small boiler. We took whatever we could put our hands on without asking questions. Water was hauled from a source five miles away and chain gangs of prisoners of war were formed to load coal into the tenders.

Although most of the locomotives and cars were U.S.A. equipment, foreign cars of all description had to be repaired. We found cars and even locomotives that the U.S.A. had sent over to France in World War I in 1917 and 1918 still going strong. Materials were very scarce and we repaired cars with what we could find or steal or salvage from other cars. If the roofs and superstructures of the box cars were beyond repairs they remained in that condition but they were boarded up on the sides and ends to a height of four feet and used as gondola cars. It was necessary at times to patch up holes with toilet paper and flattened out tin cans. Under war conditions it's not how you do it as long as the Army gets the supplies and ammunition.

The 764th at Paris

After two months we put the Le Mans terminal finally into operation for military traffic only and then turned it over to the French to work out their own salvation on the remaining problems and followed the rapidly advancing army. The Germans had just left Paris in a hurry, and we were sent there to help unravel the snarled-up congestion of traffic existing in the railroad yards and shops.

Unlike Le Mans, the shop and yard facilities were left intact. The Germans apparently never believed that the Americans would ever enter the city and they never had the opportunity to sabotage the railroad facilities as they had planned. They had to drop everything and run. We repaired locomotives and cars at the large Battignolles locomotive shops and Clichy car shops, working 24 hours a day and maintained Army hospital trains at the same time at St. Lazare Station and Gare L'Est—a very important assignment. We permitted the French to repair their own locomotives and we took care of our own, but the supervision of the whole shop came under the Army.

As in the case of Le Mans, after seven months we felt that the French were capable of being on their own and we turned the installation over to them and proceeded to Marseilles and gave the Engineer Corps a hand in processing used automotive cranes, bulldozers, trucks, etc., for shipment to the Pacific. We were also given a small railroad, having only six French locomotives and a few foreign cars which we operated and maintained.

If the war with Japan had not terminated when it did we would have been ultimately on our way to the China, Burma, India theatre. We got a "break" there.

The M. R. S. Moves Out

A more glamorous story can be told from the operating side of the military railways than from the shop side. At the time of my departure from Germany in January, the mission of the Military Railway Service was practically

(*Continued on page 253*)

Interior of the Clichy shop with Janos, Sporacio, and Wooley in the background and Steele and Triplett at the band saw

A. R. E. A. Reports on

Locomotive Economics*

A LOCOMOTIVE, regardless of type, whether it be reciprocating steam, steam-turbine, electric, or Diesel-electric locomotive is no more than a thermal and mechanical unit designed to develop ton miles per hour, with first cost and efficiency of operating performance the basic factors determining its selection. Efficiency of performance means not only availability, reliability, flexibility, tractive effort characteristics, tracking effect, and sustained horsepower, but includes maintenance and operating costs as well. As first cost increases, the importance of availability is intensified, and therefore, because of the greater first cost of the Diesel-electric, the design must display a high availability if it is to compete successfully with the more moderately priced conventional type of steam locomotive. It now does this although the efforts of steam locomotive designers and builders are gradually paring the advantage which it presently possesses.

Such illustrations and many others indicate that there are few if any instances in which Diesel-electric locomotive records reveal an average availability of less than 90 per cent in streamline service. In fact, records of 95 to 100 per cent over long periods are the rule rather than the exception. With such availability it is readily understandable why the Diesel-electric locomotive has succeeded in attaining unparalleled mileages. The exceptionally high utilization which it provides is partially attributable to assignment in special service. In many instances these Diesels are protected by steam locomotives and are out of service only when necessary because of repair or for operating considerations. Therefore, utilization is high at the expense of steam power which is standing idle to protect the special services. If a railway were completely Dieselized and the Diesel power were used for protection as well as routine service, it would be impossible to utilize all of the locomotives during the 95 per cent of the time that they are available. Therefore, while availability could remain high, utilization would be adversely affected.

The manner in which Diesel-powered streamlined trains withstood the rigors of wartime traffic has enhanced their popularity with railway operating and maintenance officers. The railways found it necessary to lengthen overall schedules but slightly during the war, and such changes were generally made to conform to ODT orders. Consider for instance the experience of the joint Chicago & North Western-Union Pacific "City of Denver" trains which operate nightly over the 1,048 miles between Chicago and Denver. Prior to the war, these trains were operating on a 16-hour schedule westbound, while 15 hours and 40 min. were required to make the trip, Denver to Chicago. At the present time the schedule westbound is 17 hours, while eastbound an hour has been added to the schedule also, making it now 16 hr., 40 min. In other words, the overall operating speeds have been decreased from 65.5 and 66.9 m.p.h. to 61.6 and 62.9 m.p.h. Even at these speeds, and consequent intensive service, these trains as of June, 1944, completed 8 years of continuous operation, 7 days per week, without being taken from service, except on two occasions when operating considerations entirely independent of the trains themselves required their removal for short periods. One spare Diesel unit has been available for each of the two-unit locomotives for substitution when it was necessary to remove a unit for periodic inspection and repair; all other maintenance has been performed at the two terminals during lay-over hours. During the 8-year period the two trains accumulated the outstanding mileage of 6,084,022, while operating over long distances, averaging speeds of 60 to 70 m.p.h., with a maximum of approximately 100 m.p.h. This is a remarkable achievement and speaks well for the availability and reliability of Diesel power.

While the utilization of the Diesel locomotive in special services is outstanding, it might be well to add that the mileages obtained in steam locomotive operation are increasing regularly. For example, the J-3 locomotives on the New York Central in 1941 averaged monthly mileages of almost 15,000 per locomotive, and individual monthly mileages of the J-3 and L-4 classes have increased to as much as 24,000. Furthermore, in 1941 the average mileage of the J-3 design between classified repairs was only slightly less than 250,000. This is a utilization which warrants strict consideration.

Maintenance Considerations

Any comparative evaluation of the availability, utilization and performance of the Diesel-electric and conventional steam design should include a consideration of the preferred treatment the Diesel usually receives in the matter of maintenance, and the fact that initially it was placed in service under most ideal conditions. The Diesel was operated at the head-end of streamline, lightweight trains, which gave it every opportunity to display the advantages which it possessed. The reduced train resistance of the lightweight streamline equipment enabled operation at high speeds with markedly reduced operating costs compared to that which would result had standard equipment been utilized. Coincidentally, higher speeds were attainable. Millions of dollars have been spent in the maintenance of Diesel locomotives and, being a new motive power type scarcely adaptable to conventional roundhouse maintenance, the Diesel has, in many cases, been serviced in modern plants by highly trained and specialized personnel. Because of the seriousness of delay arising from improper maintenance, detailed records have been maintained and the schedule for regular replacement of parts has been respected, even though wear did not indicate that replacement was essential at the time. Contrast this treatment with that given the steam locomotive which in too many cases is indifferently maintained and serviced in obsolete enginehouses with outmoded equipment. Any comparative analysis of the two power types in so far as availability is concerned should take this difference of maintenance policy into consideration.

Reliability for High Speed Operations

Reliability, or dependability, is equally important. The extended locomotive runs operated today require reliability of a high order. Weakness in this characteristic would result in very embarrassing and costly interruptions to traffic which cannot be tolerated in the competitive era just ahead. On this point the Diesel-electric stands on firm ground since it is unusual for this type to suffer a

* Abstract of a report of the Committee on Railway Location and Operation of the American Railway Engineering Association (Assignment 5) in which the committee collaborated with the Association of American Railroads, Electrical Section. The chairman of the committee preparing this report was L. K. Sillcox, first vice-president New York Air Brake Company.

complete failure, while a steam locomotive failure often means complete stoppage until replacement is secured, or repairs are made. Usually the failure of one unit of a multiple-unit Diesel means only a reduction in speed because of the reduced power available.

Further in connection with a comparative evaluation of the availability and performance of the Diesel-electric and the steam locomotive of conventional design should be mentioned the fact that during periods of fuel shortage, the steam locomotive has suffered from the effects of unsuitable grades of coal, leading in some cases to engine failure. Apparently the Diesel has received a grade of oil which does not have dire effects on its mechanism. The result is that through no fault of its own the steam locomotive sometimes shows up to disadvantage.

Diesel-electric motive power is also utilized for its efficiency in high-speed operation. Illustrative of this feature is the schedule of the Chicago, Burlington & Quincy "Twin Cities Zephyr" streamliners—a distance of 427 miles being covered in 6¼ hours with 8 stops en route—an over-all average speed of 68.3 m.p.h. Comparable schedules will probably be realized in the post-war period by many railways which hope to build a future in passenger service for themselves, through programs of track strengthening, realinement and refinement to take advantage of the potentialities inherent in modern motive power units. Such program may ultimately permit maximum speeds of 100 m.p.h. or even higher. The examples of Diesel locomotive performance to the exclusion of reference to the steam locomotive do not imply that only the Diesel can operate in these services.

However, inasmuch as the subject assignment relates specifically to the Diesel-electric, references to the steam locomotive must be secondary. The Milwaukee's "Hiawatha" service between Chicago and St. Paul embraces both Diesel and steam-powered trains, thus affording a direct comparison. The excellent performance of the steam locomotives in this service can best be demonstrated by pointing out that the Hiawatha power was designed for a train of six cars to operate at a maximum of 100 m.p.h. However, soon after inauguration of the service the train was lengthened to seven cars, then eight cars, and finally, in an emergency, to ten cars without departing from the schedule. Another example of outstanding steam locomotive performance from the standpoint of speed, regularity, and return on the investment, is the "Daylight Limited" of the Southern Pacific. There are, of course, other notable steam-powered schedules.

Steam vs. Diesel for Heavy Freight and Passenger Service

In the face of the popularity enjoyed by the Diesel-electric, and its constantly expanding use, many of the larger systems are conducting investigations designed to improve the efficiency of the steam locomotive, to keep stride with its newer competitor. For instance the Pennsylvania has built and placed in service a turbine-driven steam locomotive, in addition to its experimental 6-4-4-6, Class S-1, and 4-4-4-4, Class T-1, passenger locomotives. This same system is also responsible for the development of the multi-cylinder 4-6-4-4 type, Class Q-1, designed for high speed, heavy freight service. Tests, both road and laboratory, of the 4-4-4-4 design have demonstrated that it can handle 16 cars at 100 m.p.h. without drawing upon the full power capacity of the locomotive. It is offered as an alternate to the Diesel, and its builders maintain that it will outperform a 5,400-hp. Diesel at all speeds above 26 m.p.h. With the elimination of service delays en route, it is contended that the steam locomotive of this design can maintain the same schedules as Diesel-powered trains. Unfortunately, in too many instances the facilities for servicing a steam locomotive en route are obsolete and its performance suffers. However, this is no basic disadvantage; the deficiency is fully appreciated and there is a tendency to correct the condition.

The Chesapeake & Ohio is planning to build a steam-turbine, electrically-driven locomotive. These roads and others in cooperation with the coal industry are jointly progressing the design of modernized high capacity steam locomotives, to take efficient advantage of the low cost heat energy available in the almost limitless coal reserves. However, certain of these roads are experimenting with both Diesel and steam locomotives. For instance, the New York Central, which has long been a protagonist of the steam locomotive and has developed some of the most efficient designs, is now experimenting with the Diesel for freight and passenger service in connection with the testing of other types of motive power. Thus it is apparent that the railroads are on the threshold of a period of motive power development. The Diesel is driving the steam locomotive to new refinements and even to new forms, but whether these new varieties will cost as much as the Diesel, or offer the same degree of reliability, availability, and operating and maintenance costs, is yet to be seen.

Diesel Switching Locomotives

The Diesel locomotive has been accepted without question in switching service for several reasons. Most switching operations are performed within the speed range throughout which the Diesel displays decided advantage over its steam counterpart, and the high acceleration of which it is capable tends to speed up switching operations. It is also contended, that with the proper gear ratio, a Diesel-electric can perform the switching assignments of a steam locomotive having a horsepower rating approximately two and one-half times as much.

In switch service, too, the Diesel displays a high availability which can be effectively utilized in many yards. Oftentimes Diesel switchers are assigned on a 24-hour basis with provisions for servicing them during lunch periods or at other times when they are not being utilized. Partial explanation for the high availability of the Diesel resides in the fact that minor repairs can be made without delay that would be experienced in the case of work on a steam locomotive that would require extinguishing the fire, with an attendant cooling off period, as well as the time consumed in rebuilding the fire and generating the necessary steam pressure. Furthermore, fueling of the Diesel is necessary but two or three times per week and can be accomplished in the yard, either from stationary facilities or from mobile tanks. The steam unit, on the other hand, must go to the round-house or other stationary facility for coaling and watering several times a day, and there is the further loss of time for the cleaning of fires. In view of time-consuming operations, the steam locomotive does not average more than 68 per cent availability as compared with the generally accepted 95 per cent for the Diesel switcher.

This would indicate that five Diesel units will displace seven steam locomotives in switching service, or a ratio, steam to Diesel, of 1.4. This assumes, of course, that the motive power inventory at a specified yard is sufficient to support the ratio. The experience of one railway illustrates this fact, as is noted from the following table:

No. of Steam Locomotives	No. of Diesel Locomotives	Ratio Steam to Diesel
7	5	*1.40
17	12	1.42
32	23	1.39
8	6	1.33
1	1	1.00

* Calculated—based upon availabilities of 68 and 95 per cent for steam and Diesel power, respectively.

It will be observed that at one yard 17 steam locomotives

were displaced by 12 Diesels, or a ratio of 1.42. At another the ratio was 1.39, so that both are very close to the 5 to 7 advantage of the Diesel. However, in one yard where but one steam locomotive was assigned, obviously the substitution of a Diesel locomotive did not reduce the number of units required. Referring again to the statement that a Diesel can perform the assignment of a steam locomotive of 2½ times as much horsepower, Diesels of 600 hp. have displaced steam locomotives rated at 1,400 hp. With Diesel switchers costing $78, and steam locomotives $35, per horsepower, the following capital investment is required on the 5 to 7 basis:

Diesel
Five 600-hp. units at $78 per hp. $= 5 \times 600 \times 78 =$ $234,000
Steam
Seven 1400-hp. units at $35 per hp. $= 7 \times 1400 \times 35 =$ $343,000

This indicates that the seven steam locomotives would require an investment $109,000 greater than if five Diesels were substituted. One advantage of the steam locomotive generally accepted is that its lower first cost reduces the capital investment and incidental fixed charges. However, this is not true in yard operation if sufficient units are required. In any event, it is anticipated that the rate of interest on equipment obligations will continue to decrease, as has been evidenced during the past two years—(the average rate on obligations issued in 1943 was only 2.37 per cent). If this trend continues, the difference in investment cost will assume lesser importance relative to the differences in other costs.

Included in this report are a limited amount of comparative cost data on steam and Diesel operation for both yard and road service that were submitted by several railways. The actual values vary to such an extent as to restrict their dependability, but they are nevertheless indicative of trends and have some merit for that reason, if for no other. It is the judgment of this committee that extreme caution should be observed in attempting to apply these data to a particular set of operating and motive power conditions because of varied experiences of other systems. All such conditions must be known and compared with those prevailing in the service under examination before any recorded cost data can be intelligently applied. Of course, it is not feasible or necessary for the purposes of this report to detail all factors in each instance which affected final results. To reiterate, the costs included herein are for the purposes of indicating the general trend only.

Economics of Diesel and Steam Power in Yard Service

In the matter of operating costs the Diesel is more economical in all accounts except lubrication. It is difficult to compare direct operating expenses as submitted by various railways because of the variance in the manner of bookkeeping. Also it is necessary to consider that in most comparisons relatively new Diesel power is related to converted steam locomotives not specifically designed for switching service. For example, the steam locomotives of Road A were built in 1901 and converted in 1927. They were originally 6-wheel switchers, but when converted their wheel arrangement was expanded to 0-8-0. Their adhesive weight is 108 tons. Those of Road B weigh 133 tons, 103 tons being supported on drivers of a 2-8-2 design. They were built in 1911 and 1912, and have not been converted. The data given to the committee have been developed from costs applicable to Diesel locomotives and older forms of steam power, thus making a direct comparison impossible. However, the data on hourly costs are included as of possible interest.

Because lubrication is grouped with water and other supplies in Table I, the cost differential favoring the steam locomotive in the lubrication account is not evidenced.

Table I—Cost per Hour—Steam and Diesel-Electric Switching Locomotives

Road A, 600 and 1000-Hp. Diesels

	Steam	Diesel	Diesel Saving
Fuel	$1.12	$0.37	$0.75
Water, lubrication and other supplies	0.20	0.08	0.12
Enginehouse expense	0.47	0.04	0.43
Repairs	1.31	0.43	0.88
Wages of enginemen	1.82	1.91	−0.09
Depreciation	0.23	0.55	−0.32
Total	$5.15	$3.38	$1.77

Road B, 1000-Hp. Diesels

	Steam	Diesel	Diesel Saving
Fuel	$1.07	$0.33	$0.74
Water, lubrication and other supplies	0.11	0.03	0.08
Enginehouse expense	0.23	0.04	0.19
Repairs	1.06	0.55	0.51
Wages of enginemen	1.78	1.75	0.03
Depreciation	0.13	0.41	−0.28
Total	$4.38	$3.11	$1.27

Table II—Unit Costs—Steam vs. Diesel, Yard Service, Road C—Year 1944

(600- to 1000-hp. Diesels; 6 and 8-wheel steam switchers)

	Steam 1,253,750 yard-hr. cost per yard hr.	Diesel 306,857 yard hr. cost per yard hr.
Fuel	$1.65	$0.39
Water	0.10	...
Lubrication	0.08	0.07
Other supplies	0.05	0.02
Enginehouse	1.22	0.52
Repairs	1.87	0.71
Wages	6.43	5.60
Total	$11.40	$7.31
Total, excluding wages	4.97	1.71
Total for steam wages same as Diesel	10.57	7.31
Fuel per hour	927 lb.	6.6 gal.

Note.—In this instance, the saving for the Diesel is reflected in lubricants also. This is not in accord with general practice.

Table III—Hourly Operating Costs of 0-8-0 Steam Switching Locomotives—Road D

Fuel ($3.25 per ton)	$1.08
Water, lubricants, and other supplies	0.12
Enginehouse expense	0.54
Repairs	1.02
Wages of enginemen	2.17
Depreciation	0.44
Total	$5.37

However, one railway states that the charge to lubrication in the case of its 600 hp. Diesels is 4.0 cents per hour as compared with lubricating costs for a steam locomotive of 2.6 cents. This indicates a saving favoring the steam locomotive of 1.4 cents per hour. To the above costs it is necessary to add taxes, insurance, and interest to obtain an over-all comparison. These additional accounts would individually favor the steam because of its lower capital costs. For comparative purposes, experience data of another railway are shown in Table II.

Table III, recording the costs of Road D, is applicable to the more modern steam power specifically designed for yard service. The cost data are based upon a lot of 80 locomotives, 65 being built in 1930, 5 in 1942, and 10 in 1943. They are 8-wheel switchers with 25-in. by 28-in. cylinders and 52-in. drivers, weighing from 240,000 to 244,000 lb. Carrying a boiler pressure of 200 lb., they develop cylinder horsepower of 2,252. Based upon an original cost of $83,800 per unit and an availability of 75 per cent, hourly depreciation is determined to be but $0.44 when a depreciation rate of 3.5 per cent is applied. The hourly operating costs of these locomotives, as submitted by the operating railway, are shown in Table III.

Diesel vs. Steam in Freight Service

The latest field of railway operation which the Diesel has entered is freight service. As in other services, the Diesel can accelerate throughout the low speed range at a higher rate and can handle heavier tonnage because of its higher starting tractive effort and even torque. One railway states that, in comparison, the tonnage rating of steam locomotives on a 1.27 per cent ruling grade is 3,200, while

that of the 5,400-horsepower Diesel with a 61/16 gear ratio is 3,500. If this gear ratio is changed to 62/15 the rating is increased to 3,800. The steam locomotives in this instance are of modern design and are considered comparable with the Diesel-electric power used in the same service. While it is stated that the steam locomotives are believed to be comparable, it should be observed that some authorities contend there is no common ground upon which to compare the performance of the Diesel and the steam locomotive. This opinion may be traced to the unrealistic manner in which horsepower ratings are determined. The Diesel locomotive is rated according to the horsepower output of the Diesel engine, but it can deliver no more than 85 per cent of such horsepower at the rails. It would appear that the Diesel should be rated at its maximum horsepower at a given speed, or throughout a speed range, as is done in the case of the steam locomotive. As of interest, the tonnage ratings and maximum speeds are shown in the tabulation as functions of the gear ratio (for three gear ratios). These values are predicated upon a ruling grade of 2.2 per cent and when operating without helper service.

Gear Ratio	Tonnage Rating on 2.2 Per Cent Grade	Maximum Speed on Level Track
59/18	1700	80 mph.
61/16	2000	70 mph.
62/15	2300	65 mph.

The same railway furnishes operating and cost data covering seven months of 1941 which are shown in Table IV. It will be noted that the Diesels were new, while the steam locomotives were three years old. This would affect the operating costs.

Table IV—Freight Locomotive Operating Data

	Steam	5400-Hp. Diesel
Mileage	455,216	216,725
Availability—per cent	75	90
Utilization—per cent	36	62
Car-miles per train-mile	82.5	89.3
Gross ton-miles per train-mile	3,400	3,801
Gross ton-miles per train-hour	92,303	107,940
Train-miles per hour	27.15	28.39
Average number locomotives in service	10	3
Average cost per locomotives	$174,000	$490,000
Date built	1938	1941

Costs Per Mile	Steam	Diesel	Diesel Saving
Repairs	$0.30	$0.23	$0.07
Depreciation	0.08	0.20	*0.12**
Fuel	0.33	0.28	0.05
Lubricants	0.01	0.05	*0.04*
Water and other supplies	0.05	0.002	0.048
Enginehouse expense	0.04	0.01	0.03
Wages of enginemen	0.18	0.15	0.03
Total cost per locomotive-mile	$0.99	$0.922	$0.068
Total cost per thousand gross ton-miles	$0.2908	$0.2254	$0.0654

* Figures in italics represent differences favorable to the steam locomotive.

The Diesel locomotive was initially popular on western lines where long distances were traversed with consequent saving in time for servicing en route. Also, the water conditions are relatively poorer in the west, from the standpoint of both supply and quality. The long heavy grades and in some instances the existence of tunnels are further factors favoring the Diesel locomotive in the west. In connection with heavy grade operation, it should be mentioned that considerable difficulty has been experienced from the burning out of motors in low-speed, heavy-grade operation. This is a danger, of course, which the steam locomotive does not present.

For comparative purposes it is interesting to note averages provided by a western road* for a year's operation:

	Steam	Diesel
Gross ton-miles per train-hour	29,747	52,985
Gross ton-miles per locomotive-mile	1,624	2,998
Train-miles per train-hour	13.55	17.67
Repair cost per mile	$0.44	$0.23
Power type—articulated		5,400-hp.

No age figures are given, although the indications are that the steam locomotives are not of the most modern design. For example, in contrast with the $0.44 per locomotive-mile for repair costs given above, a railway operating with modern articulated freight units, roller bearing equipped, reported a repair cost of $0.237* per mile. In comparison, the Norfolk & Western** reports that its unit repair costs for the 2-6-6-4, Class A, design is $0.21, while that for its 4-8-4, Class J, locomotives is but $0.115 per mile.

Another system* operating in the mountainous territory of the west has furnished the following operating data:

	Steam	Diesel
Miles operated	700,000	400,000
Per cent total time in service	32	59
Per cent at shop or terminals	46	11
Per cent available but not being used	22	30
Gross tons per train	2,610	3,325
Total operating cost per mile	$1.70	$0.82
Repair cost per mile	0.74	0.20
Fuel cost per mile	0.58	0.34

Effect of Age on Diesel Repair Costs

In a preceding paragraph it was pointed out that the Diesels involved were new, and to indicate the manner in which repair costs vary with age, Table V is included: (No doubt a portion of the increase is attributable to increased labor rates and material costs and inefficiency of inexperienced labor necessarily employed during wartime.)

It will be noted that maintenance costs on new Diesels are very low and tend to rise rather rapidly in early years of service. Adequate records are not presently available to indicate when a period of stability is reached, nor are the records of one road necessarily comparable with those on another, because of the age factor, wage levels, shop facilities, number of locomotives being serviced, etc. Furthermore, when special facilities are required for the maintenance and servicing of Diesel locomotives, that cost should be included in any comparative figures. On the other hand, as a railway increases its use of Diesel power, the need for steam power facilities decreases, offsetting, to a degree dependent upon local conditions, the Diesel facilities expense.

Also in connection with Diesel repair costs, consideration should be given to the possibility that the values

Table V—Relation of Unit Repair Costs to Age—Diesel-Electric Locomotives

	Repair Cost—Cents	
Freight:	Per gal. oil	Per 1000 g.t.m.
1941—First year	3.48	7.97
1942—Second year	5.56	11.63
1943—Third year	7.79	15.48
1944—Fourth year	10.29	20.80
Per cent increase:		
1944 vs. 1941	195.69	160.98
Passenger:	Per gal. oil	Per Passenger car-mile
1941—First year	4.11	1.05
1942—Second year	5.51	1.56
1943—Third year	9.30	2.72
1944—Fourth year	13.05	3.75
Per cent increase:		
1944 vs. 1941	217.52	257.14
Switching:	Per gal. of oil	Per yard-hr.
1941—First year	4.34	29.04
1942—Second year	6.21	39.82
1943—Third year	9.44	60.94
1944—Fourth year	10.85	71.15
Per cent increase:		
1944 vs. 1941	150.00	145.01
Total	Per gal. of oil	
1941—First year	4.04	
1942—Second year	5.65	
1943—Third year	8.86	
1944—Fourth year	11.65	
Per cent increase:		
1944 vs. 1941	188.37	

* Railway Age, May 19, 1945, p. 888.
** Railway Age, June 2, 1945, p. 971.

shown do not reflect actual cost. This statement is based upon the understanding that in some instances, with the introduction of the Diesel, the builders of the locomotive have guaranteed a maximum maintenance figure. Should it happen that this value was exceeded, the manufacturer agreed to absorb the extra costs. While this may not have been the situation generally, it possibly should not be overlooked. In this same connection, the fact that Diesels are standardized has operated to their advantage in repair cost when compared with that necessary to maintain the steam counterpart in service.

This standardization has enabled the railways to maintain supplies of standard parts at strategic points, thereby permitting prompt replacement at a minimum cost, and incidentally increasing the unit's availability and utilization. On the other hand, the railways insist upon individual design of their steam locomotives which means such a multiplicity of parts that the maintenance of supplies at numerous points is not feasible. This is no inherent weakness of the steam locomotive, and it is unfortunate that its performance and maintenance cost records must suffer through no fault of this type of power.

It is evident that fuel costs are undergoing considerable change and may do so for some time to come, as indicated by the bituminous coal wage increases for instance. While there have been increases in the cost of Diesel fuel, the effect per service unit is not as significant as in the case of coal. To illustrate, the following figures are quoted: the cost of locomotive coal was $2.45 per ton in 1940 and $3.33 in 1944; in the same years locomotive coal cost 96 cents per yd. switching-hour as compared with $1.37—an increase in excess of 42 per cent with a further increase due in 1945. The increase in the cost of Diesel fuel per yard switching-hour in the same period was from 28 cents to 32 cents, or less than 15 per cent. These figures indicate the importance of the study of relative trends in cost of fuels utilized—and the long term availability of solid vs. liquid fuels.

In comparing labor costs, often there are extra expenses incurred in cases where it is found desirable to have a maintainer ride the Diesels continuously.

Summary of Factors Governing Motive Power Selection

The data in Table VI may suggest that Dieselization is indicated in the interest of economy. This is not true

Table VI—Estimated Diesel Savings—Year 1944

Service	Operating Savings	Per Cent as Compared to Steam Operation	Investment
Freight	$1,223,999	44.6	$4,000,000
Passenger	820,725	26.3	2,945,000
Switch	1,002,226	30.8	2,866,750
Total	$3,046,950	33.5	$9,811,750

Service:	Per Cent Return on Investment	Equivalent No. Steam Locomotives	Number Diesels In Service
Freight	30.6	30	8,5400 hp.
Passenger	27.9	40	7,4000 hp. 3,2000 hp.
Switch	35.0	72	39,600-1000 hp.
Total	31.1	142	

since if the service to which the power is to be assigned cannot support high utilization, then the economies of Diesel operation cannot be realized because of the high first cost. Based upon 1944 costs, the 5,400-hp. freight Diesel cost approximately $496,000, while the 6,000-hp. passenger design exceeded this cost by $26,000. Contrast these values with that of the 4-8-4 steam locomotive which in the same year cost $225,000, and it is immediately apparent that high utilization must be obtained if the elevated first cost of the Diesel is to be defended.

Complete familiarity with the main characteristics of the three types of motive power—electric, steam, and Diesel-electric—is a prime essential in selecting either the type or combination of types best adapted to a particular situation. In summary, the following results are noted:

Regarding operating costs, the electric locomotive is at a disadvantage in fuel costs, the Diesel-lubrication in lubrication costs, while the steam is at a disadvantage in fuel, water, enginehouse expenses, and repair costs, the exception being lubrication.

With reference to fixed charges, a decided superiority is realized by the steam locomotive in each of the three items of: First cost; depreciation; and interest, taxes and insurance. The electric shows advantage in depreciation costs, while the Diesel-electric enjoys no advantage at all, except in yard service when Diesel switchers can displace steam power on a 5 to 7 basis.

With regard to operating characteristics, the steam locomotive is at a disadvantage in each of the six considerations of overload capacity, high acceleration, availability, flexibility, use factor, and freedom from complete breakdown; the electric shows an advantage in all but the last two mentioned, and the Diesel-electric in all but the first mentioned.

In consideration of special features, the steam locomotive is again at a disadvantage, while both the electric and the Diesel-electric enjoy superiority in smoke elimination, damage to roadbed, merchandising appeal, and dynamic braking.

Finally, in respect to the possibility of eliminating facilities relative to operating and maintenance, the steam locomotive rates no advantage, while the electric and Diesel-electric enjoy superiority in both of these possibilities. An offset to this, however, is the fact that economical maintenance of any substantial number of electric or Diesel-electric locomotives requires specialized shops entailing substantial capital expenditures in addition to those made for the locomotives.

E. T. O. Army Transportation

(*Continued from page 248*)

completed. Sinee V-E day the problem has been one of gradually turning the railroads over to the civilian railroad employees in the occupied and captured countries of Italy, France, Belgium, Holland and Germany, carefully screening every employe to be sure that he has no pro-German or Nazi party connections and to be satisfied that the occupational military traffic is handled effectively. From my own observation the Germans are taking over their badly disrupted railroads in the real spirit of cooperation and can be trusted. Maybe the added assurance of having three square meals a day and the presence of our occupational forces have something to do with it, but nevertheless they are making the best of the conditions existing and doing a good job. The Germans must work or else they get no food ration card.

The Military Railway Service loaded and transported more than 18,500,000 net tons of military material during the 11 months between D day and V-E day and considerably more tonnage thereafter on over 25,120 miles of track in western Europe alone with 1,937 locomotives and 34,588 freight cars. I am happy and proud to have had the privilege to serve in so great an undertaking that played so great a part in bringing about the defeat of our enemy.

USS Designs

All-Welded Cor-Ten Hopper

Car now being exhibited is based on study of 65,000 Cor-Ten cars now in service by the Railroad Research Bureau—Smooth welded interior, free from frame members, reduces opportunities for corrosion

IN THE 11 years since the introduction of USS Cor-Ten, car builders and railroads have used this steel in more than 65,000 freight cars with an average saving in dead weight of more than two and one-half tons per car. After studies of the operating records of these cars, the Railroad Research Bureau of United States Steel Corporation Subsidiaries presents an all-welded, lightweight USS Cor-Ten hopper car of new design for inspection by railroad officers and car builders. This car, built to order for Carnegie-Illinois Steel Corporation, was first shown at Roanoke, Va., on April 2 and 3, with subsequent appearances as other railroad centers. Of particular interest are the new types of joints embodied in the construction. These are all welded and simplify construction, provide tight seals against moisture, and eliminate laps.

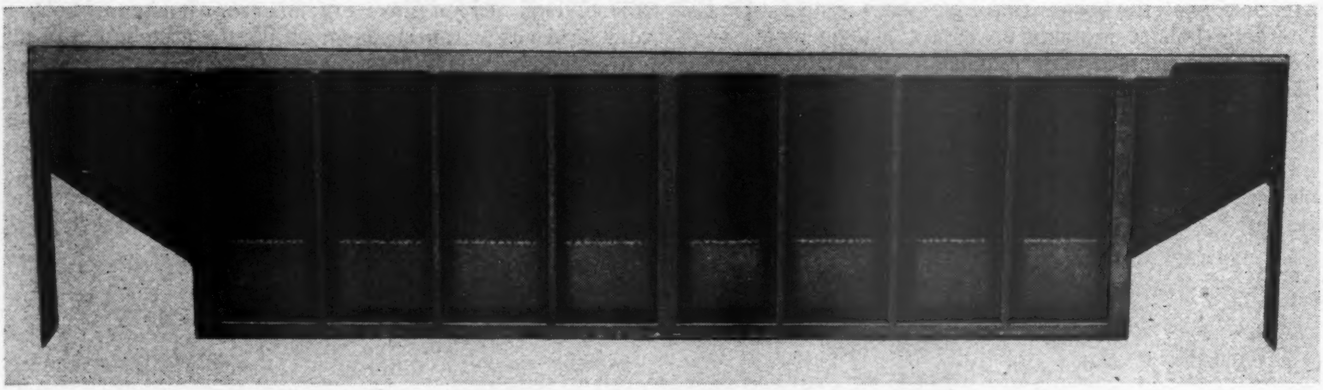
When empty the new all-welded car weighs only 33,500 lb., a saving of 6,540 lb. over the A. A. R. standard hopper car built of carbon steel. This saving has been translated

The hopper sheets are stiffened with three longitudinal braces

Comparative Weights and Dimensions of the USS All-Welded Cor-Ten Hopper Car and an A. A. R. Standard Carbon Steel Design

	USS Cor-Ten	A.A.R. Standard
Nominal capacity, lb.	100,000	100,000
Light weight, lb.*	33,500	40,040
Load limit, lb.	135,500	118,960
Journal size, in.	5½ x 10	5½ x 10
Inside length, ft.-in.	34—2	33—0
Inside width, ft.-in.	9—9 13/16	10—4
Height, ft.-in.	11—0	10—8
Cubic capacity, cu. ft.:		
Level	2,273	2,145
10-in. heap	2,553	2,408

* With One-Wear wrought-steel wheels.



Outside elevation of a car-side subassembly

The partially assembled car body shows the absence of interior ledges and seams—The side on the floor is ready to be placed in position

into increased cubic capacity, which allows more revenue freight each time the car is loaded. Because of its reduced weight, the car is equipped with empty-load brakes.

In general, the car does not differ radically from the lines of the conventional A. A. R. standard design. For economy and simplification in fabrication, the use of standard sections and plates with straight trim and simple cold bends was one of the basic concepts of the design. Hot pressing and elaborate die work were avoided. The car structure is designed for subassemblies which will facilitate assembly and permit position welding, these subassemblies of the under-frame, sides and ends being all welded together in order to form the complete car.

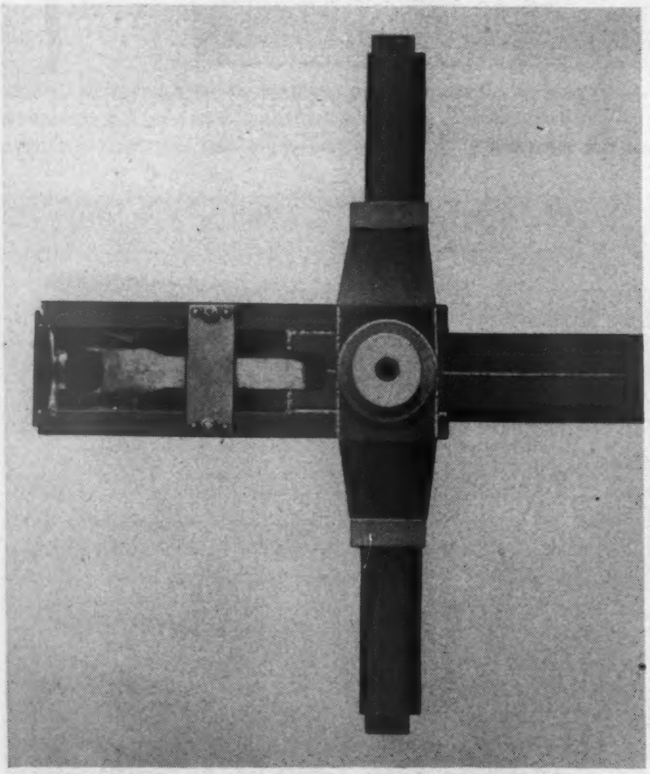
Protruding structural members and seam ledges have been eliminated from the interior of the car by means of outside stake side construction. This side framing has additional horizontal stiffness which compensates for the omission of the inside diagonal center braces. Such a smooth interior surface permits the free flow of lading when unloading and helps avoid damage to the car by mechanical devices used in unloading or loading. Ledges and pockets where moisture can collect are also eliminated, thus reducing the possibility of corrosive attack.

To obtain maximum unloading area in the hopper-door openings, and to reduce weight, a new welded tubular center sill has been used. This facilitates the use of a one-door opening across the car. The tubular center sill is terminated at the face ends of the draft-gear back stops with the face plates welded to the ends of the sill, thus transmitting the buffing forces directly to the full cross section of the center sill. Standard Z-26 draft sills extending from the bolster to the end of the car form a draft-gear pocket of standard dimensions. The draft sills are secured to the tubular center sill by welds which will develop strength equal to the full cross section of the sills, all welds running parallel to the line of stress.

The hopper sheet, which is formed by two simple cold bends, extends in one piece from one side of the car to the other. Its sloping sides engage and are welded to the corresponding slopes of the angles forming the bottom chords of the side girders. Specially designed longitudinal braces

extending from the bolster to the end sheet assure stiffness. The body bolster is made up of a Carnegie wide-flange beam with a pressed-plate extension on the top flange to facilitate the connection to the sloping floor sheet and to provide a more yielding contact between the floor and the bolster.

Each side is a main subassembly. The side sheeting is made up of two longitudinal sheets, the heavier being in the lower portion, which encounters the greater wear and abuse. This heavier sheet extends from bolster to bolster and serves as a framing member for the attachment of all cross members and floor sheets. The upper sheet is of lighter gage and also extends from end to end of the car. These sheets are welded to a frame structure consisting of channel section vertical posts and top chord and an angle section side sill or bottom chord. The latter is inclined, forming a water-shedding shelf and providing the proper slope for the attachment of the hopper sheets.



Under side of the center sill and body bolster showing the backstops bearing directly on the end of the box-type sill

The A end of the car

Locomotives of Tomorrow

(*Continued from page 244*)

ducing a locomotive prime mover with excellent availability and low maintenance expense.

Given a 2,000-hp. gas turbine, it is possible to design a gas turbine locomotive for high speed, heavy duty passenger service. In a single cab, weighing 325 tons, and employing a 4-8-8-4 wheel arrangement, four 2,000-hp. gas turbine-generator sets can be installed. These sets, placed side by side, consume less than 60 per cent of the total cab length leaving over 40 per cent for other necessary apparatus. Eight of the driving axles would be equipped with motors, providing 100,000 lb. starting tractive force when the motors are geared for a maximum speed of 120 m.p.h. The weight per horsepower developed would be considerably less than that of present self-propelled locomotives.

An 8,000-hp. gas turbine locomotive for heavy duty freight service, with 16 driving axles could be built in two units. It would weigh approximately 450 tons, with all weight on the driving axles. The starting tractive force would be 225,000 lb. and the continuous tractive force 160,000 lb. at 15 m.p.h., or 100,000 lb. at 24 m.p.h. The locomotive maximum speed would be 70 m.p.h.

Without question, we all know that the gas turbine will reach its widest field of application when coal can be used as a fuel. When this can be achieved, the gas turbine will be a serious competitor to all other types of power. The burning of coal satisfactorily in a gas turbine is no easy problem, and I hesitate to predict when it will be solved. Many people and many organizations are working hard to surmount the obstacles that must be overcome, and it may be with us sooner than some expect.

Development work in burning coal is following along two major lines:

1—To pulverize the coal to such fineness that complete combustion can be secured in the burners with no damaging solid material carried over into the turbine blade path. This system may require, for its successful use, preparing coal in stationary plants prior to placing it on the locomotive.

2—To pulverize the coal to accepted central station practice and then separate any remaining solid matter after burning, by means of centrifugal cleaners, before the products of combustion enter the turbine.

So that you will not be misled, I would like to add one word of caution. The gas turbine locomotive is not going to be cheap. The prime mover is constructed from about the highest price materials known augmented by precision manufacture of all parts. It will definitely be more expensive than steam power, and probably in the order of Diesel power.

There is now, and in the future, a definite place on the American railroads for all types of motive power. We, of the Westinghouse Company, so strongly believe this to be true that we are lending our efforts without discrimination, and to the limit of our facilities, to the perfection of all types—electric, gas-turbine, steam and Diesel.

EDITORIALS

Packing Retainers Being Watched

The principal result sought by the installation of various types of journal-box-packing retainers—namely, elimination of waste grabs, hot boxes due to this cause and attendant train delays—is so important that railroads are installing these retainers in large numbers. The Association of American Railroads has recognized the potential merit of packing retainers and ruled, in effect, that they be maintained and given an opportunity to show what they can do. Needless to say, their operation and effectiveness are being watched with the keenest interest.

Railroads have for many years depended primarily upon the human element in freight-car lubrication, especially in the application and readjustment of journal-box packing. There has been no assurance that the packing will remain properly adjusted for any specified time, or that any two car men will do exactly the same kind of job.

Apparently each journal-box packer tends to become an individualist on this question and interprets the instructions and rules more or less to suit his own particular ideas. For example, one man will push the packing down in the front end of the journal box, while another will push it down in back, or perhaps on one side of the journal only, both assuming that their own particular conception of how to adjust packing is the only way to eliminate hot boxes.

As the journal rotates, being in contact with the waste packing, strands become loosened from the main body of the packing and adhere to the journal. They are carried upward to the brass which, if it is poorly fitted, permits such particles to be drawn underneath the brass. This action is, of course, augmented when brasses actually tip or bounce off the journals due to rough handling, passing of cars over railroad crossings, or the application of brakes.

In these cases larger pieces of packing may enter and be trapped under the brass, the resultant excessive friction and heat destroying lubrication, cutting the journal and causing a hot box. Practical car men feel so strongly about this prolific cause of hot boxes that, at the April meeting of the Car Foremen's Association of Chicago, they practically pleaded with car designers to produce some improvement in journal-box details which will positively prevent freight-car brasses from tipping or lifting off the journals.

The other method of approach to the problem is to install some device which will prevent either lint or larger pieces of packing from being carried higher than one inch below the journal center line, in which case this material cannot, of course, get under brasses even if they bounce completely off the journal, as sometimes happens. It is the function of journal-box retainers to keep packing down where it belongs, thus preventing waste grabs, and a number of different designs have been developed for this purpose.

Packing retainers, which accomplish their objective and possess the added desirable requisites of simplicity, reliability, potential long service life and non-interference with ordinary servicing of journal-box packing, are a good investment almost regardless of cost, although every element which goes into the construction of conventional freight cars is subject to close scrutiny from a cost standpoint. A single hot box caused by a waste grab, however, may well cost more than several thousand journal-packing retainers.

Railroads can well afford to give this device a thorough test and, particularly, see that enough are installed and service conditions are maintained so as to give the device a real test. It is highly important for railroads to know how effective journal-packing retainers are in meeting this urgent problem of preventing waste grabs and hot boxes which delay trains and are a large item of what should be avoidable expense.

Training and Countertraining

Characteristic of the accidents caused by the failures of locomotive boilers due to low water, is the fact that there is no evidence of defective equipment, such as safety valves, steam gauges, water glasses, gauge cocks, and boiler feeding apparatus, in most of the cases, and that in many of them, because of the death of the occupants of the locomotive cab, no information is obtainable as to whether or not these men had warning of the development of low water. But in three of the eight cases reported for the fiscal year ended June 30, 1945, the evidence is clear that the engine crews were aware of the danger of their situation in time to have prevented the accident had they followed the prescribed course of action decisively. It may reasonably be inferred that this is also true with respect to considerable numbers of the cases in which no evidence is available.

During a period of about seven and one half months since the close of the fiscal year reports of investigations of ten accidents caused by overheating of the crown sheets due to low water have been issued by the Interstate Commerce Commission. In the case of one of these there were contributory defects and in another, evidence that there may have been a false water-level indication. One accident was clearly the culmination of procrastination on the part of the crew and in another, while action

was taken promptly to meet the low-water situation, it was only partially effective. In the remaining six cases there is no evidence to indicate the cause of the accident.

Again, the number of cases in which the engine crews are known to have allowed the few minutes available between the loss of the water level and ultimate disaster to run out while they try desperately to avoid a complete engine failure by restoring the lost water level, clearly suggest that similar courses were followed by the engine crews in many of these cases.

These recent accidents again emphasize what has been suggested more than once before; that is, that psychological factors are as important as, if not more important than, defective equipment as causes of boiler explosions. In recognition of this some railroads have posted illustrated warnings and instructions for dealing with low-water conditions conspicuously in locomotive cabs.

Such methods are, no doubt, of real value. One may express a doubt, however, that they will overcome the psychological handicap which persistent attention to the importance of getting trains over the road has built up in the minds of the men in the cab when they are suddenly faced with the rare emergency presented by the loss of the water level. Nothing less than the frequent notices of fact and comment now addressed to the enginemen by a few roads reminding them of their responsibilities when low-water emergencies occur can compete with the daily urge to maintain schedules.

Welding Rules Must Be Observed

The record of poor welding done during the early days of welding in locomotive and car shops continues to serve as a brake on the full utilization of this tool in railroad construction and car work. It is a reminder of the need for continued care in determining the locomotive and car parts which can be welded safely and in adhering strictly to approved techniques performed by skilled operators.

At the meeting of the Railroad Division, The American Society of Mechanical Engineers, on April 2, 1946, at Chattanooga, Tenn., the session on welded locomotive boilers indicated the caution which the Interstate Commerce Commission found necessary to use in agreeing to the construction of new all-welded boilers. This caution was apparently the result of past experiences with unsound welding practices which produced conditions that did not help to promote safety in train operation. The unsound practices were due to several reasons, some of which were the lack of understanding of the parts that can be welded safely with the equipment available to railroad shop forces, unskilled operators, improper welding procedures and the temptation to "fix" defects in a hurry to save time and money.

In a written discussion of welded boilers presented at the meeting, John M. Hall, director, Bureau of Locomotive Inspection, Interstate Commerce Commission, set forth the conditions under which the I.C.C. would agree to the construction of all-welded boilers. They included the requirement for detailed specifications and drawings to accompany the request for permission to build the boilers and compliance with the A.S.M.E. code provisions applicable to welded joints in steam-boiler shells. Mr. Hall stated that none of the railroads have the facilities to build all-welded boilers in their shops and meet the I.C.C. requirements. If cracks develop in the shell these will have to be repaired by the use of riveted patches and not by welding. The welding of cracks in boiler shells without stress-relieving is just as bad a welding practice as it was 20 years or more ago when it was used with unfortunate results.

Welding is producing excellent results in hundreds of parts used on locomotives and cars. Its more general acceptance as a safe "tool" to use will depend upon the complete understanding of its possibilities and limitations, upon the careful observance of tested procedures and upon the adequate training of operators. Disregard of these essentials will continue to retard progress in the use of welding in railroad work to its full potentiality.

A. R. E. A. Reports On Diesel Economics

Since Diesel power first became a factor of any importance in the handling of trains in railroad service there has been a continual controversy over the relative cost of operation of this type of power and that of steam power. Like every other development of its kind the rather meager cost statistics that were available in the early days of Diesel operation did not, in any sense, reflect a true picture of either steam or Diesel performance for the simple reason that small numbers of Diesel units were being compared with larger numbers of steam units. Then, too, in the experimental stage of the Diesels the initial cost of the equipment naturally included some of the expense of the engineering development work. These factors, and many others, contributed to a distortion of Diesel costs as compared with those of steam.

It seems that every time an article is published in which comparative costs are given or a committee prepares a report in which such costs appear the publication is hardly out of the wrapper in the executive offices of our railroads before a mechanical or operating man is invited into the front office and asked, "How do these figures compare with our operation?" or "Why aren't we doing as good as this?" Of course in those cases where the published figures are obviously not as favorable as the current statistics of the individual road in question the man in the front office rarely ever bothers to bring the matter up at all. Instances such as this have come to our attention so often and have, on so

many occasions, been so embarrassing to some of our good friends out on the line that we have almost been tempted to delete cost figures from articles unless they could be documented to such an extent as to leave no doubt of the specific conditions under which they originated. Unfortunately, there are many reasons why this is not always possible. So, if we are to have statistics at all we will have to take them where and when we can find them, with or without that proverbial grain of salt, as the mood may dictate.

Elsewhere in this issue is a most comprehensive report on the economics of Diesel-electric locomotive operation which was prepared by a committee of the American Railway Engineering Association in collaboration with the Electrical Section, AAR Engineering Division under the chairmanship of L. K. Sillcox. This committee has done its customarily fine job of recording the developments in the field of motive-power economics and, like all committees of its kind, probably found itself in the position of having to complete the report without being able to include anywhere near all of the data that they had planned to include and in some measure of disappointment at its inability to obtain just the kind of data that it had hoped for when the report was conceived. However, the job was done and the records of Diesel vs. steam operation are thereby enlarged.

The included statistics are a valuable addition to existing information on the subject and they are presented to our readers with the warning that the figures may be used against them.

The summary of factors presented by the committee governing motive-power selection call attention once again, and wisely so, to the fact that, in the case of the Diesel, "if the service to which the power is to be assigned cannot support high utilization then the economies of Diesel operation cannot be realized because of high first cost." In these days of increasing motive-power costs attendant upon efforts to increase efficiency this may also prove to be true of other types of motive power as well as the Diesel.

Modern Steam Power Needs Modern Repair Shops

The controversy over the superiority of steam or Diesel equipment has established the fact that each has certain jobs to which it is best suited. But a fact yet to be established is whether or not the method of comparison gives the steam locomotive an even break.

Admittedly, the day is gone when old steam power is called upon for comparison with new Diesels. But the day is not gone when the maintenance of new steam locomotives must bear the burden of the use of obsolete shop machinery. On many, if not most, roads, modern steam locomotives are being maintained by obsolete shop equipment, which, even when new, was not designed for the close tolerances and high productivity now required.

Why, then, is this machinery not replaced? The mechanical department may answer this by stating that they cannot get the money. Management may offer the excuse that the expenditure can not be justified, but it frequently overlooks the fact that expenditures for special facilities have returned dividends in the maintenance of Diesel equipment. The same can be done for steam power.

What effect future developments will have on determining the type of motive power best suited for train handling cannot be accurately forecast at the present time. One thing, however, is certain. Steam locomotives possess the advantage of high horsepower at low initial cost, and as long as they are still with us—they probably will be for a long time to come—why not save dollars and cents by intelligent investment in the tools necessary to keep them running at low over-all cost?

NEW BOOKS

Machine Tool Guide—*By T. C. Plumridge in collaboration with R. W. Boyd, Jr., and James McKinney, Jr. Published, 1945, by The American Technical Society, Chicago. 630 pages, 8-in. by 11-in. Illustrated. Bound in cloth. Price, $7.50.*

This publication is a compilation of the specifications and dimensions of machine tools manufactured by 61 companies, 42 of which are well-known suppliers of the tools used extensively in railroad shops. It is the most complete work of its kind that has come to our attention and should prove valuable to designers, shop engineers, supervisors and others in the mechanical department concerned with the selection, installation or use of shop machinery. From a railroad man's standpoint it would be worth while to have complete information of this kind on all railroad shop machines but the publishers of this work have, of necessity, confined this volume to the basic machines which are more or less common to machine-tool-using industries. Such omissions as the railroad man may observe will usually be found to be in the category of special machines peculiar to railroad work.

The book is made up in 21 tool groupings such as boring, drilling, grinding and milling machines and lathes, planers, shapers, etc. In each of these groupings are the technical data relating to the products of several manufacturers of that type of machine.

The value of this book to the shop engineer or others concerned with plant layout could be considerably enhanced by the inclusion of general foundation and floor space dimension for all of the principal machines. That this is planned for future editions is indicated by the foreword wherein it is stated that "A reference work of this type can never be complete in its first edition . . . We were limited to available information suitable for reproduction, but are hopeful that new facts and new drawings will be available for each succeeding edition."

With the Car Foremen and Inspectors

Terminal

Conditioning Passenger Cars*

Time-tested standard practices and new methods and equipment are credited with record performance in servicing cars so as to avoid delays and failures

THE war emergency intensified all efforts in the problem to combat and control the common enemy of modern railroad transportation—train detentions and failures enroute. The prime responsibility, not only with the mechanical but other departments as well, is to keep transportation schedules free from delays and failures, some of which are often difficult to explain.

With shopping programs deferred during the lean years of the depression era and before passenger equipment could be rehabilitated in keeping with its former standards, we entered World War II with the demand for every available passenger car for the transportation of military personnel and vital war materials. Many skilled mechanics left their respective positions in shops and train yards. An acute shortage of essential materials was soon experienced. In brief, mechanical department forces were confronted with what seemed an almost impossible task to perform; however, determined efforts and ingenuity kept passenger equipment rolling with a minimum amount of delay and failure. The preparation of cars by untiring shop and terminal forces and adherence to past standard practices turned the trick.

Shopping of equipment excluded, our committee study develops that, regardless of the depression and the war, standard practices have been followd in preparation of cars for road service and new methods and ideas are being constantly introduced to prevent delays and failures which of course are going to play an important part in meeting competitive means of transportation with the reconversion program now in the making.

Delays caused by hot boxes, truck and brake-rigging defects, train separations, hose parting, brakes sticking, flat wheels and failures of steam-heat, air-conditioning and electrical equipment are thoroughly investigated in every instance in order to determine definitely if caused by man failure, faulty equipment or lack of maintenance. This procedure has been responsible for setting up many new standard practices for mechanical-department forces to follow in the daily and periodical maintenance afforded.

Journal Boxes

It is generally conceded that the preponderance of train detentions can still be attributed to hot boxes and at the same time it is also agreed that there has been a marked reduction due to advanced strides made in journal-box construction and type of cover used, dust guards, bearings, waste renovation and the systematic checking, and in periodical attention. We know that there are several conditions which create a progressive heated journal bearing. Mechanical-department officers are familiar with these conditions, however there is one subject that may be of interest and that is the cases where the journals have heated in the first 100 miles, due in most instances to waste grabs or accumulations of lint and short strands of waste along the edge of bearings and which has prompted many carriers to recheck all journal boxes a second time at their passenger terminals. Careful inspections with a flashlight and using a hook to disengage small strands of waste that have started to work up under bearings has had the desired effect in preventing potential hot boxes, delay and possibly the setting out of cars at points enroute. These waste grabs usually occur after boxes have been serviced or repacked at coach yards and cars are enroute to the passenger terminals.

Generally, all boxes, friction and roller bearing, are inspected and felt with the bare hand upon arrival of inbound passenger trains at terminals and while they still contain heat. If any particular box is found operating above normal temperature it is chalk marked with a cross for the guidance of coach-yard forces, who jack the box up and make their inspection of bearing, journal, wedge, etc., to determine definitely the cause of the heating. Each year, additional railroads are finding it practical to contract the renovating of their waste at some central plant. The improved facilities in these plants produces a better product, one which is playing an important part in affording better lubrication and assisting in reducing hot box difficulties.

With the advent of cold weather there is always a prevalent increase in the number of hot boxes and resultant delays, indicating rather conclusively that the elements are a contributing factor and largely responsible for conditions that cause a lack of lubrication. One of the principle reasons is the entry of moisture into the boxes causing the oil to become emulsified and the waste frozen, therefore it is extremely important to have tight and properly fitting journal box covers. Loose and poorly fitting covers will permit the entry of dirt and dust during the summer and moisture during the winter, hence many boxes have to be repacked frequently and in some cases

* Abstract of a report prepared by a committee of the Car Department Officers' Association, of which C. P. Nelson, assistant superintendent car department, Chicago & Northwestern, is chairman.

every trip. A tight-fitting flanged cover has recently been introduced with marked success, tests proving that foreign substances are not gaining entrance into boxes, keeping waste clean, resilient and comparable with its original state when applied.

Periodical bearing inspection and repacking of journal boxes is generally handled on a four-month cycle. In performing this work, journal boxes are jacked, bearings are removed for inspection and replaced if worn or defective. Box, journal and wedge are also carefully checked for wear and defects. Boxes are repacked and then usually rechecked by a supervisor in charge of lubrication.

Roller bearings and their maintenance was covered by your committee during 1942 and from recent observations there has been no decided deviation in the manner of servicing or periodical maintenance other than the fact that some railroads are now contemplating the scrapping of axles on either an age or mileage basis.

Trucks—Draft Gears—Couplers

The general inspection of trucks, springs, wheels, brake rigging, draft gears, couplers, etc., is usually made on the arrival of trains at coach yards by competent car inspectors. This inspection, dependent on the efficiency and qualifications of the car inspectors selected for this important class of work can prevent failures and delays, therefore supervisors share a responsibility in seeing to it that they have the right men chosen for this work. The supervisor should also contact and discuss problems daily with these inspectors and serve to keep them alert and on their toes. The car inspector should be given to understand that he is responsible for the safety of passengers and that he cannot become lax or careless, for if he does, failures will ultimately occur. When car inspectors find defects and chalk mark them for repairs in the train yard or on the repair track, supervisors must see to it that correct rpeairs are made. If this is not done, car inspectors may become discouraged and possibly careless. This must not happen. The car inspector must feel that it is strictly up to him to be vigilant at all times to locate existing defects, and when he does, the correction of those defects rests with the supervisor. When cars are marked to the repair track for a change of wheels or some other defect, it is generally the practice to check them for height, leaning, side-bearing clearance, coupler parts and slack in draft gears, supports for all underneath appurtenances suspended from sills, brake hangers, pins, cotter keys, etc. Tests of the air brakes and steam-heat equipment are also made, following up with whatever repairs are necessary. Some railroads have a practice in effect whereby a semi-annual inspection is made of coupler parts in the train yard and stretching cars for slack.

Steam-Heat Equipment

There are two systems of steam heat used in railway train service: one is a high-pressure system, while the other is a low-pressure or vapor system.

The distinguishing feature between the two systems is that the vapor system regulates the admission of live steam to the radiating pipes, but allows condensation to escape in the atmosphere freely at all times; whereas the high-pressure system admits steam freely at all times to the heating coils, but regulates the discharge of the water of condensation from the radiating pipes. In both systems, this regulating is accomplished by one or more automatic valves located in a vertical steam trap on each car.

In the low-pressure system, about the most important piece of equipment is the vapor regulator which automatically maintains the pressure in the heating coils at atmosphere, regardless of the pressure in the train line. When the cut-out valve is open, the supply of steam to the radiating pipes is controlled by the temperature of the water of condensation that is escaping through the outlet for condensation under the car. The temperature of the water of condensation actuating the expansion diaphragm in the outlet of the apparatus controls the steam admission by means of the automatic steam admission valve. This requires that the condition of this diaphragm be one of the first items to be checked and that it be known to be OK. The disc and valve located in the upper part of the regulator should also be checked. In addition to checking the regulator, another item of great importance which should be checked is the strainer. This is located in the tee of the steam train line leading to the constant-pressure valve. This strainer has a tendency to collect rust lodged in the steam train line and if it is not removed and cleaned it will automatically cause a restriction in the branch line leading to the constant-pressure valve.

After the vapor regulator has been checked, is known to function and is adjusted properly, the cut-out valve should be checked to insure that it seats properly as, otherwise, should steam not be desired in the radiating pipes, steam may by-pass into these pipes, causing discomfort to passengers.

Following the heating system through the car, all radiating pipes should be checked for possible leaks, especially in the various joints or connections. As the cooling influence caused by the weather on any exposed piping underneath the car causes considerable condensation to take place, and this reduces the steam pressure in the train line considerably lower in the rear of the train than it is in the front end, good workmanship demands that all of this piping be kept properly covered and all ragged and loose insulation be repaired or replaced. This precaution also avoids the possibility for fires to be started in ragged insulation from brake-shoe sparks.

Should it become necessary to repaint any of the radiating pipes for appearance and other purposes, the old paint should first be scraped off, as too many coats of paint on top of each other reduce the effectiveness of the heating system and tend to mar rather than improve the appearance.

Next, the end valves should be checked to insure that those between the cars making up the train will not close while the train is speeding across the country, and that the one on the rear end or last car can be regulated so that it can be cracked only sufficiently to permit the condensate to escape in the volume the heating system demands and to avoid freeze-up. If the stems on end valves are not packed in the packing boxes, the valves will have a tendency to close enroute.

This brings us to the final link by means of which steam is passed from one car to the other and permits us to heat trains of any length, dependent upon the capacity of the locomotive, namely, the steam hose or metallic connectors, the ends of which are equipped with coupler heads. Gaskets should be checked to see that the proper gasket is in coupler head. These should be checked closely for worn gaskets and other leaks. Any sign of even the smallest leak should be promptly corrected. Small leaks will progressively increase, with a resultant drop in steam pressure, increased fuel consumption and marked decrease in the efficiency of the entire heating system, especially on the rear end of long trains. The need for eliminating all leaks promptly has grown in importance during the summer months, since the advent of some of our modern air-conditioning systems, which require a certain minimum of steam pressure on each car if they are to perform properly.

Modern blower-type heating systems, automatically controlled, have added responsibility onto coach yard

maintenance forces. These systems require that after trains arrive in the coach yards, all heating valves should be checked by hand to determine whether or not they operate freely. Electrical circuits should be checked for grounds, thermostatic circuits and thermostat tubes should be tested with steam on the car and allowed to cycle on and off to determine whether or not they function properly. Control panels should be checked for good contacts and relays checked to see that they operate properly. If any defects are found, necessary steps should be taken to correct them. Body grilles and recirculating grilles should be checked to see that all are in proper position. Filters must be checked and changed out, if necessary. Overhead coils should be Oakited and ducts blown periodically. Blower fans should be tested each trip and should also be periodically inspected and serviced.

Air-Conditioning Equipment

Attention on Completion of Each Trip

With the air-conditioning systems running, operate the various control switches, observing the response of the blower fans, exhaust fans, heat valves, compressors, etc.

Make visual inspection of relay contacts. Clean or replace as required.

Check all fuses and note that all are tight in receptacles.

Examine and work the magnetic steam heating valves manually. Adjust any that are found to be tight or sticking. Inspect switch contacts. Note that valves go to *Off* position when cooling is turned on and operate properly when the control switch is set on the heating position.

Cars equipped with modulated cooling control should be operated a sufficient length of time to determine that modulation is being provided.

On cars equipped with the auxiliary hold-over system, evaporating condenser, water spray, or sub-cooler controls should be checked for proper functioning.

On direct mechanical cars note speed-control current if equipped with current indicator and, on cars not equipped with current indicators, check voltage drop across caterpillar test terminal with volt meter.

Additional Attention at 30-Day Intervals

Check and test all thermostats and tubes. Mercury tubes should be made to open and close by using hot and cold applications to the mercury bulb.

Check temperatures in cars equipped with modulated control and compare with the outside temperature. Any adjustments necessary because of improper modulation should be made in accordance with manufacturers' recommended practice.

Check all a.c. and d.c. relay contacts. Dust off with a soft brush. Clean lightly with approved abrasive material all that are burnt or pitted. Adjust any that are bent or misaligned. On direct mechanically-equipped cars, note especially the operation of the cooling pilot and shock-relief relays, by turning cooling on and off several times. Lubricate the hand-operated switch points with petrolatum if dry. Tighten all terminals.

Check the operation of the low-voltage protective relay, if used, for proper drop-out voltage.

Check the operation of pressure switches and compare settings with master gages to determine if they open and close at the required and approved pressures. Readjust when necessary.

Cars also equipped with temperature switches should have temperature setting checked to determine that they open and close at correct temperatures. Place the bulb in a cup of water along with a thermometer, keeping the water agitated. Add ice, and salt if necessary to obtain lower temperatures necessary for some of the settings. Adjustments should be made in accordance with manufacturer's recommendation.

While temperature and pressure switch boxes are open, the interior should be thoroughly cleaned, the contacts brushed with a soft brush, or cleaned with approved abrasive material when found necessary.

Check operation of all other thermostat valves, including water-spray, drain valves, etc., for proper functioning and make adjustments wherever required.

At least once each month, run cooling equipment for a long period to permit the controls to function under actual conditions. On cars with auxiliary holdover, switch over to brine operation and freeze brine until controls shut down the system. Observe all temperature and pressure settings and note that controls are functioning properly.

Cars equipped with a motor timer on the compressor panel should have the motor and contacts checked and lubricated with approved lubricants. The compressor should be started several times and the operation of these controls noted.

Additional Attention at Yearly or Seasonal Inspections

Clean the front and back of all relay panels. This includes power and control equipment.

Clean and overhaul the a.c. starter and power receptacles, where used.

On direct mechanical cars, the speed-control circuit should be energized, and the current tested with an ammeter. With the contacts of the caterpillar in normal or closed position, the reading should be 7½ to 10 amp. on a 32-volt circuit, and 4 to 6 amp. on a 64-volt circuit. Contacts should then be opened, and reading should show 3 amp. or less. A reading of 4 amp. indicates some of the contact leaves are not operating properly. These can be located by testing across adjacent leaves with a voltmeter, or usually by visual inspection.

Apply insulation test to the control circuits. Insulation value of car wiring with battery and thermostat tubes disconnected, should meet specified resistance.

Electrical Equipment

When a passenger car is brought into a terminal and sufficient time given, inspection and repairs to car-lighting equipment are to be made as follows, to eliminate failures on departing trip.

Inspection of the inside of the car consists of turning all lights and other electrical devices on so that a full discharge load is across the batteries. A voltage reading is to be taken across the battery circuit at the switch to determine the state of charge of the battery. A reading is then taken between the positive battery switch to ground, and the negative battery switch to ground, to determine if the equipment is free of grounds. Grounds should be removed if more than 10 volts.

Inspection is to be made of all sockets, wiring, fans and other accessories for defects and repairs made.

Regulators and electric lockers should be kept clean and free of any equipment that may cause interference with the functions of the car-lighting regulator or air-conditioning equipment.

Fuses should be inspected for proper capacity and good electrical connection maintained, replacing improper or defective fuses.

Inspection is to be made of train-line receptacle and connector, maintaining good electrical connections and proper polarity.

A periodical inspection card should be installed in electric lockers and noted by inspectors to keep them posted of periodical inspections completed.

On the outside of the car, the following inspections and repairs are to be made:

Inspection of lead batteries should consist of specific-gravity reading of sulphuric acid to determine the state of charge of the batteries and the height of the solution, which must be watched closely. Batteries must be charged when the specific-gravity reading is low, and flushed with distilled water before the solution reaches the level of the tops of the plates. Care must be taken that cells are not flushed to excess, in which case a cell filler of proper type is to be used with an indicator warning the user when the proper level is reached.

When batteries are flushed, the date should be marked on the periodical card. If it is found that a battery requires too much flushing, a check should be made of the car-lighting regulator and proper adjustments made to cut down the amount of charge given the battery.

Tops of batteries, boxes, leads, etc., should be kept clean and free of grounds. Inner battery connectors, as well as car wiring, must be carefully watched, keeping leads well insulated and clear of corrosion and poor electrical connections.

The same inspection should be given Edison batteries with the exception of reading of the specific-gravity. A periodical specific gravity must be taken of the Edison battery by using an Edison hydrometer, and the solution changed in cells when the specific-gravity reaches a low point of 1,160.

Inspect the generator and axle pulleys for loose bolts and other defects, and check the alignment of the pulleys which must be kept perfect to protect belt life and true running betwen the pulleys. Recrown armature pulleys when they become flat.

Proper belt length must be maintained. The length of belt should be stencilled on the body of the car near the armature pulley for the maintainer's information if the belt is missing. This information should also be carried on the periodical inspection card. Inspection of the belt for wear and defects should not be overlooked. When the belt is worn out or damaged, a repaired or a new belt should be applied.

Generator suspensions should be inspected and worn parts replaced.

Lubrication of bearing parts, shafts, etc., should be made periodically, and noted on the inspection card.

Generator bearings and shafts should be inspected and kept free from defects. Lubrication of bearings should be done periodically, according to maker's instructions.

Generator brushes, pole changer, armature, leads, etc., should be carefully maintained. Brushes should be replaced before they are too short, which will cause poor commutation, resulting in burning of armature commutator. Proper tension should be maintained on brush-holder presser fingers at all times.

The pole changer should be kept clean and lubricated to insure positive polarity changing.

Generators are to be periodically blown with compressed air to rid them of carbon dust and dirt.

Generator leads inside and outside the generator should be maintained to insure proper insulation and good electrical connection. All periodical inspections should be noted on the card, as well as any changes that have been made in the equipment.

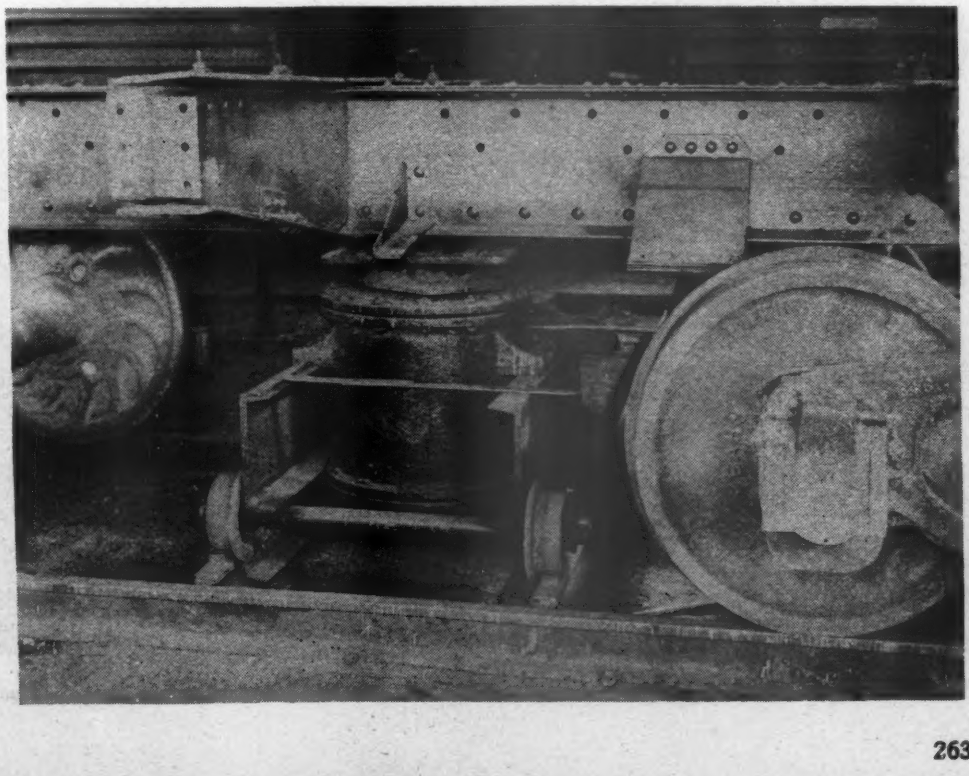
If the card is removed, a new card is to be supplied with the last periodical inspection date appearing on the card that has been removed.

* * *

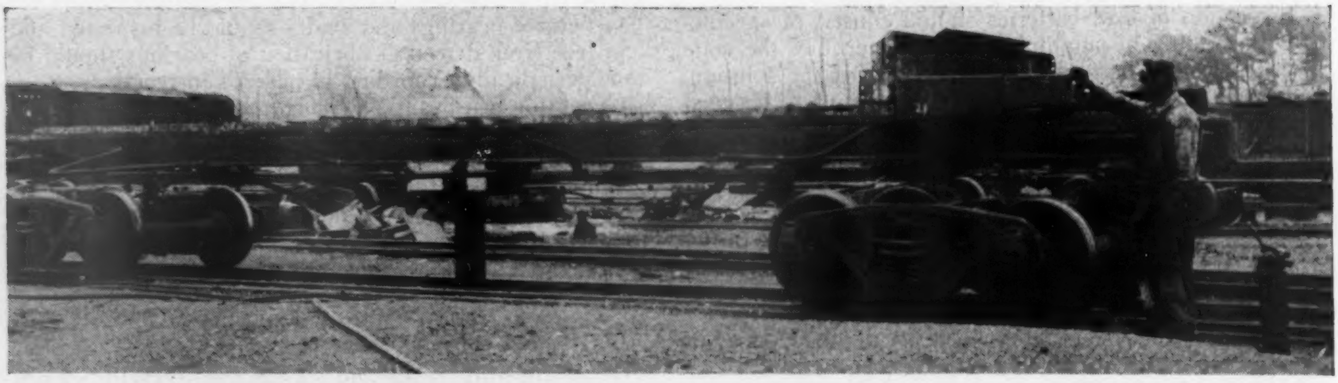
Hopper-Car Program at McComb Shops

The illustrations give four views of extensive car rebuilding operations now being carried on at the McComb, Miss., car shops of the Illinois Central. This shop turned out the last of 700 twin-hopper, 50-ton cars in 1945 and is now working on an order for 299 triple-hopper, 70-ton cars; 750 of these cars, in addition, have been authorized for complete overhauling.

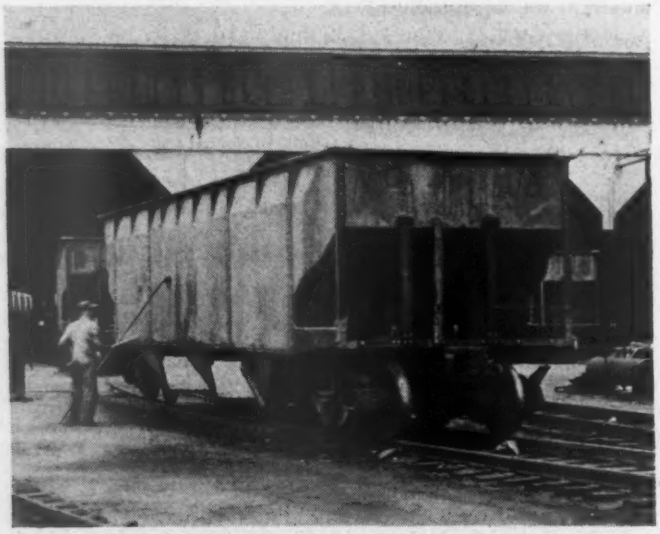
The operation consists of stripping the old cars down to the original underframe and center sill which are then sand-blasted and taken into the shop where new individual parts and sub-assemblies are applied by the progressive method and the cars turned out of the shop practically the equivalent of new cars. The normal production is six cars a day, which means a move in the assembly line every 1 hr. 20 min., but owing to recent difficulty in getting



16-in. passenger brake cylinder strongly supported on four small flanged wheels and rigid frame which may be easily moved on cross-rails under a car frame and used to lift the frame when removing or applying trucks in a car shop*



Stripped frame of an Illinois Central 70-ton hopper car



A 70-ton hopper car just out of the McComb shop

materials and other considerations, the production has been cut to three cars a day.

A feature of the operations is the use of a number of ingenious jigs for making sub-assemblies such as the car sides, hoppers, ends, doors, etc. In each case, the assembly jig assures maintaining standards which will permit all parts to fit together quickly on the assembly line. In addition, each jig is arranged for adjusting to any desired angle or even turning upside down, if necessary, for more convenient riveting, or welding. In the main, these cars involve riveted rather than welded construction.

The problem of getting materials where they are needed and in desired quantities in the car shop is of primary importance. An example of the attention given this matter at the McComb shops is afforded by the fact that the underframes, after being sand-blasted, are all turned, if necessary, so that the B-ends of the cars enter the shop towards the north.

The primary reason for this is that air-brake material, for example, assembled in one direction at one of the stations in the shop, can be applied to the cars without the labor and delay involved in turning it.

Referring to the upper illustration, the operation of turning a stripped car frame on its trucks will be seen. A large air cylinder is set in the ground at this position and used to raise the car frame which can then be swivelled and lowered on the same trucks in case the car must be turned in order that the B-end face towards the shop.

Truck side frames, bolsters, draft gears, couplers and yokes are taken to the reclamation shop for inspection,

Seventy-ton triple hopper car on raised track for painting the trucks and underframe

repair, welding and normalizing. Most of these parts are sand-blasted to assist in detecting cracks. No-Krode rust-preventative is sprayed on and serves as a primer for the coat of paint subsequently applied.

The operation of painting the car trucks and underframe is greatly facilitated by means of a short section of raised track on which the car is pulled at one end of the shop, as shown in the second illustration. The track elevation is about 30 in. which brings the trucks and underframes up to a level where they can readily be seen and can be reached with the paint-spray nozzle.

The third view shows a hopper car just out of the shop and the fourth, a group of three hopper cars and the end of a string of refrigerator cars, many of the latter being repaired and reconditioned at McComb shops for the heavy seasonal movement of strawberries and other seasonal perishable products.

Air Brake Questions and Answers

HSC Equipment on Passenger Cars and Diesel A and B Locomotive Units

Operating Instructions

411—*Q.—Should it become imperative to stop in the shortest possible time and distance to save life or avoid accident, what must be done?* A.—The brake-valve handle should be moved quickly from whatever position it may be in to emergency position and left there until the train has been brought to a full stop.

412—*Q.—What is equivalent to a brake-valve emergency application?* A.—A conductor's valve emergency or a broken-brake-pipe emergency application produces high-pressure application equivalent to a brake-valve emergency application.

413—*Q.—How is the maximum brake-cylinder pressure controlled in all types of emergency applications?* A.—The maximum brake cylinder pressure is limited initially in proportion to train speed, and is progressively reduced to the lower values as train speed decreases.

With speed-governor control in effect the stop is completed with the 40 per cent braking ratio which is retained and keeps the train from moving under any condition until the brakes are normally released by proper brake-valve manipulation.

414—*Q.—What must be done to release the brakes and recharge following a brake-valve emergency application?* A.—Depress the brake valve handle or foot-valve pedal, and move the brake-valve handle to release position.

415—*Q.—When changing operating ends on double-end equipment (two A locomotives) what procedure should be followed?* A.—Move the handle of the S-40-C brake-valve to full application position. With the MS-40 brake-valve handle in release position, turn the brake-valve shifter lever to automatic (A.U.) position. Move the MS-40 brake-valve handle to service position and make a 20-lb. brake-pipe reduction, after which move the brake-valve handle to lap position. Close the cut-out cocks under the MS-40 and the S-40-C brake valves. Move the S-40-C brake-valve handle to release position. Withdraw both brake-valve handles and proceed to the other end.

416—*Q.—Can the brake-valve handle be withdrawn in any position?* A.—The MS-40 handle can be withdrawn only in lap position and the S-40-C handle in release position.

417—*Q.—What must be done to assume control at the other end?* A.—To assume control at the other end, depress the foot-valve pedal and insert both brake-valve handles. Move the S-40-C brake-valve handle to full application position. Move the MS-40 brake-valve handle to release position and turn the shifter lever to straight-air (S.A.) position. Then move the MS-40 handle to full self-lapping service position. Open the cut-out cocks under the MS-40-C and S-40-C brake valves. After brake-cylinder pressure builds up to about 25 lb. the foot pedal may be released.

418—*Q.—Before releasing and proceeding what should be done?* A.—Gauges should be checked to make sure that brake-pipe and main-reservoir pressures are fully charged before releasing and proceeding.

419—*Q.—What should be done if the operator should leave his post with the equipment charged?* A.—If the operator should leave his post of duty with the equipment charged, it is necessary to advance the brake-valve handle to full self-lapping application position, thereby applying the brakes. This will provide a maximum brake application, which will be maintained against leakage until the operator returns and releases the brakes in the normal manner.

420—*Q.—When the compressors are not operating locomotive engine shut off), what should be done to maintain main-reservoir pressure if the operator leaves the locomotive for any considerable period of time?* A.—Enough hand brakes should be set to insure that the locomotive or train will not move.

421—*Q.—What should be done before starting the locomotive again?* A.—See that air and hand brakes are released and that main reservoirs are fully charged.

422—*Q.—If it is found necessary to haul the locomotive dead in the train, what should be done?* A.—Close the cut-out cock beneath the MS-40 brake-valve and remove the brake-valve handle. Open the ⅜-in. cut-out cock in the dead engine-fixture pipe immediately ahead of the C-1-20-8 strainer and check valve. This charges the second main reservoir from the brake pipe. Keep the independent brake valve in release position.

423—*Q.—How are the locomotive brakes then controlled?* A.—From the automatic brake-valve on the towing locomotive.

424—*Q.—In double heading when two or more Diesel A units are operated together, how are the brakes controlled?* A.—From the leading unit in accordance with preceding instructions.

425—*Q.—What should be done on all other A units?* A.—Close the cut-out cocks under the MS-40 and S-40-C brake valves and remove the MS-40-C brake-valve handle. The brakes are then controlled from the leading power unit.

426—*Q.—When double-heading an A unit behind a steam locomotive what should be done?* A.—Move the shifter lever of the MS-40 brake valve to automatic (A.U.) position. Close the double cut-out cock under the MS-40 brake valve. Leave the double cut-out cock under the S-40-C brake valve open.

427—*Q.—How are the brakes then controlled?* A.—From the steam locomotive.

428—*Q.—What control can be maintained by the engineman on the second unit?* A.—An emergency application can be made by the engineman on the second unit by moving the MS-40 brake-valve handle to emergency position, and the pressure on the Diesel unit can be reduced or "kicked off" by manipulation of the S-40-C brake valve.

(NOTE: This concludes the series of questions and answers on the HSC equipment.—EDITOR)

IN THE BACK SHOP AND ENGINEHOUSE

Machine Work and Flame Hardening at Marshall Shops

Production of Throttle Lever Latches

The manufacture of steam-locomotive throttle-lever latches at the Texas & Pacific locomotive shops, Marshall, Tex., is of particular interest because of the method used for cutting a number of latches from a single bar of steel after it has been drawn out and suitably machined instead of machining each latch as a unit.

The bar of open-hearth steel in this instance is drawn out to 1½ in. thick by 5½ in. wide by about 24 in. long and the latch teeth milled the entire length of the bar in a single cut. As a matter of fact, two bars are clamped to the milling machine table just far enough apart so that the milling cutter operates between them and cuts the teeth in both bars at the same time, thus equalizing the thrust on the milling machine spindle.

One of the latch bars is then moved to a shaper where the edge opposite the teeth is rounded and the corners adjacent to the tooth section champered or beveled Experience indicates that these bevel cuts must be taken after the teeth are milled as it is practically impossible to make the tooth-cutting mill operate satisfactorily unless it is forming both sides of the tooth.

With the latch bar rough machined, it is then taken to the Wells No. 8 cut-off saw, illustrated, where sections ⅝-in thick are cut off, being subsequently finish-machined on a shaper to ½ in. thick, drilled and slotted for a keeper bolt and spring guide rod. The teeth are also case hardened to give increased resistance to wear.

Flame-Hardening

The flame-hardening machine, illustrated, has been constructed using shop materials and a limited number of Oxweld detail parts at Marshall. It is used to increase the surface hardness and wear life of many locomotive parts such as engine-truck rockers and rocker seats, spring saddles, locomotive guides, knuckle pins and reverse-lever quadrants. Certain car parts such as center-casting wear plates are also surface hardened on this machine as well as pile driver gears, etc. With a double flame, surfaces 8 in. wide by 10 ft. long can be hardened and, if necessary, a single flame can be reduced to 2 in. in width. The water head is attached to and follows immediately behind the flame head in order to give the desired hardening effect.

The sheet-metal table of the machine is 12 ft. long and supported on a steel frame made of scrap boiler tubes. It carries a four-wheel carriage operating on a 20-in. gage track and the 5-in. wheels are spaced 18½ in. on centers.

"Slicing" a bar of pre-machined steel for throttle-lever latches at the T. & P. shops, Marshall, Tex.

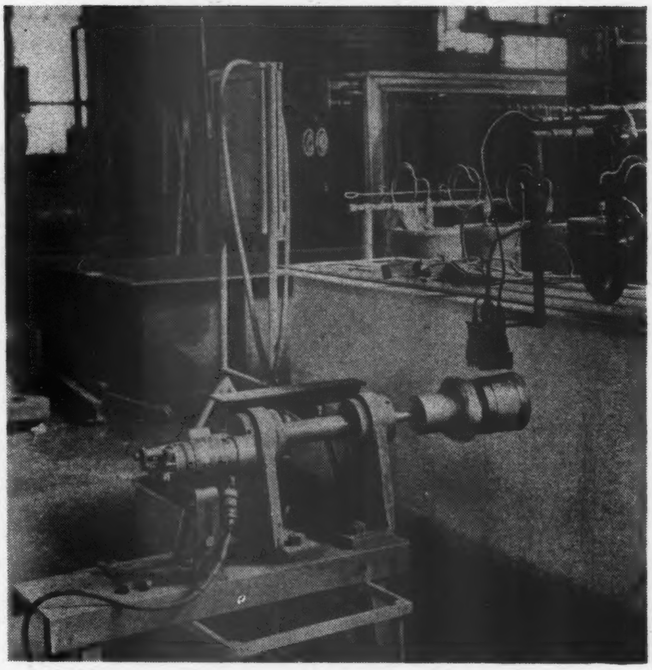
A secondary carriage gives 9 in. cross travel by means of a feed screw and handle shown at the front of the machine. This secondary carriage in turn supports a square top plate which has 6 in. vertical travel by means of a hand feed screw and a central guiding column which projects downward through a close-fitting hole in the secondary table. This top plate is used as a base on which to clamp necessary oxygen, acetylene and water pipe lines, all of which are controlled from one operating valve.

The flame and water heads used in flame hardening are brought down to the front of the machine and, being supported from the top plate, have both vertical and cross hand-feed adjustment. Longitudinal movement of the flame-hardening machine along the table is secured by means of a small variable-speed electric motor connected to the four-wheel bottom carriage and equipped with a pair of driving trunnions which engage a single aluminum track on the center of the machine table. This machine is also equipped with small coil springs between the top plate and the secondary cross carriage to take up vibrations caused by operation of the heavy steam hammer in the blacksmith shop.

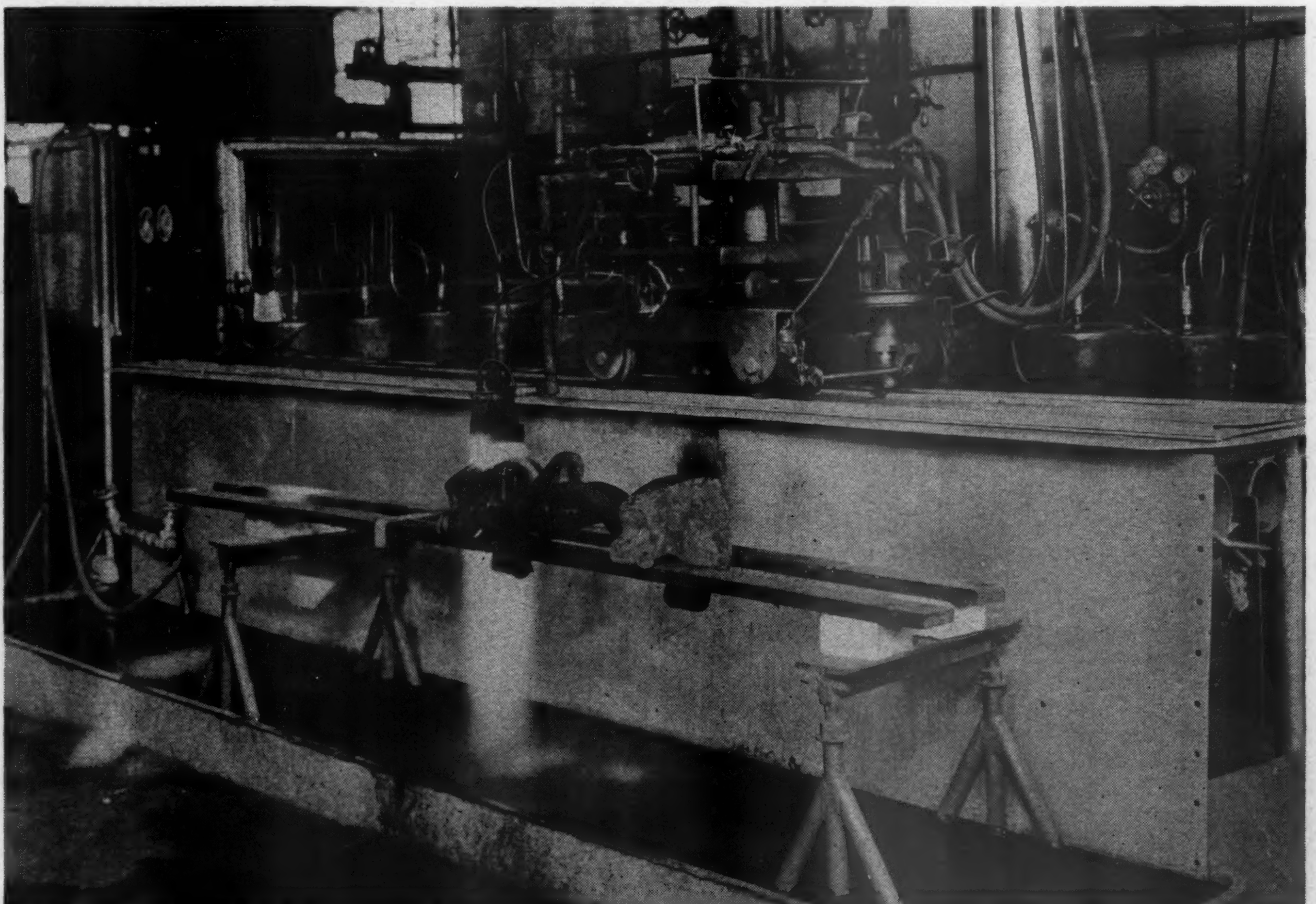
To avoid waste of cooling water, a shallow pan is located along the front of the machine and a large front steel sheet, or apron, deflects water into the pan. Two neat metal horses are inserted in the waterpan and may be easily adjusted for long or short work-supporting bars as required. The outlet from the water pan is connected to a steam syphon which discharges the water into a large cooling vat outside the shop building.

The machine is operated at different speeds dependent upon the Brinell hardness required. With .41 to .47 carbon steel, engine-truck rockers, such as those shown in the larger illustration, require a flame speed of about 8 in. per minute to give 500 to 525 Brinell hardness; links require a speed of 6 in. per minute to give 600 to 650 Brinell hardness; alligator-type crosshead guides require a flame travel of somewhat over 5½ in. per min. to give the desired surface hardness.

For hardening round material such as the knuckle pin



The work-supporting fixture used in flame-hardening knuckle pins



Flame-hardening machine built at the Marshall shops of the Texas & Pacific being used for hardening engine-truck rockers

shown in the smaller illustration, special work-holding equipment must be used. This pin is mounted on an adapter applied to a shaft which is turned by a variable-speed electric motor. The entire unit is supported on a small steel stand equipped with brackets, bearings and electric-motor drive. In this instance the flame and water heads are held stationary and the work is revolved. For the .45 carbon-steel knuckle pin shown in the illustration, the motor speed is adjusted to give a surface speed of the pin of 6 in. per minute to assure a Brinell hardness of 600.

Three Back Shop Devices

*By J. R. Phelps**

Drilling Holes in Smokebox and Saddle

In drilling the bolt holes through the smokebox and the cylinder saddle when new cylinders are applied, the holes should be drilled radially from the center of the smokebox. The equipment shown in Fig. 1 permits rotation of the air motor and drill around the longitudinal axis of the smokebox and keeps the drill in a radial position for every hole. Using this device, 78 holes 1¼ in. in diameter by

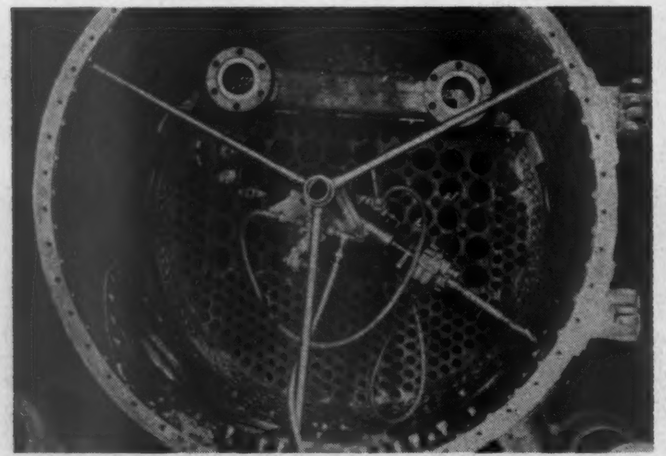


Fig. 1—Equipment for drilling and spot-facing radial holes in the smokebox and cylinder saddles when new cylinders are applied

4¼ in. long can be drilled, spot faced, reamed and the bolts and nuts applied in a maximum of 20 hours. A long-stroke air hammer is used for driving the bolts and an impact wrench tightens the nuts at the same time.

The center shaft about which the motor rotates is made of 4-in. cold-rolled tubing 7½ ft. in length. It is supported at the center of the flue sheet by a bracket bolted to the sheet and having a 3 3/16-in. cylindrical lug that will fit the inside diameter of the tubing. At the front of the smokebox the center shaft is held in place by three 1¼-in. pipe braces located 120 deg. apart. At the center the braces are screwed into pipe couplings welded to a sleeve with a 4 1/16-in. inside diameter, the latter supporting the main center shaft. One of the three pipe braces has a 1¼-in. nut welded to the outer end. A 1¼-in. bolt used with the nut wedges the front shaft support firmly into the smokebox.

One feature of the equipment is an air cylinder that controls the feed in place of the usual hand-operated feed screw. This cylinder is welded to the clamp that suspends the cylinder from the main center shaft. It has a 4-in. inside diameter and the piston has an 8-in. stroke. A three-way valve directs the air flow into either end of the cylinder and permits pressure to be applied on the air motor in two directions, outward for drilling and inward for spot-facing. When spot-facing, the air motor is connected to the feed-cylinder piston rod by means of a yoke and a special drill socket having a collar to take the upward thrust. The air pressure in the feed cylinder is controlled by a reducing valve located in the air hose between the pit connection and the cylinder.

* Machine shop foreman, Atchison, Topeka & Santa Fe, San Bernardino, Calif.

Planing Tool for Crosshead Gibs

A mirror finish on babbitted crosshead gibs is obtained by use of a planer tool wide enough to take a cut the full width of the gib. The tool shown in Fig. 3 also saves

Fig. 3—Wide tool for planing crosshead gibs with full-width cut

three-quarters of the time required to plane the gibs.

The tool holder of forged steel is 16⅝ in. long with a 1⅝-in. by 2⅜-in. shank. The bottom of the holder is 9¾ in. wide by 3 in. high and is offset 5 in. from the front surface of the shank. The holder has a machined lip, 2½ in. by 9¾ in., which acts as the supporting surface for the cutting tool. The latter is held in the holder by two ⅝-in. by 1½-in. cap screws, the tool-steel holes being drilled and tapped and the tool-holder holes being drilled only.

Drill Jig for Bell Yoke and Shaft

Repairs to locomotive bells frequently require the renewal of the bell shafts. A jig is shown in Fig. 2 for hold-

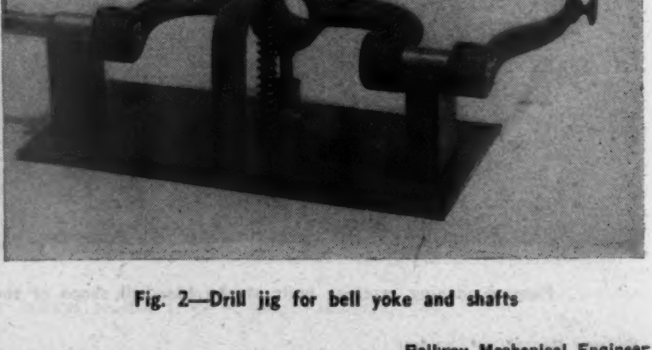


Fig. 2—Drill jig for bell yoke and shafts

ing the yoke in position while drilling the holes in the new shaft in line with the holes in the yoke. With this device the holes can be lined up, the yokes clamped down, and the job is ready for the drill press.

The base of the jig is a piece of $\frac{1}{2}$-in. boiler plate, $10\frac{1}{2}$ in. by $20\frac{1}{4}$ in. The two vee blocks are of $1\frac{1}{2}$-in. steel, 3-in. wide and 5 in. high, with 90 deg. vees machined $1\frac{1}{8}$ in. deep. The center support is a $\frac{5}{8}$-in. set screw threaded into a $\frac{5}{8}$-in. bolt welded to the base plate which permits adjustment of the yoke position while leveling. A strip of $\frac{3}{8}$-in. steel, $1\frac{1}{2}$ in. wide, $7\frac{1}{4}$ in. high and 7 in. long clamps the yoke in position. The clamp is tightened by the $\frac{5}{8}$-in. threaded rod welded to the base plate and extending through a 21/32-in. slot, $1\frac{1}{4}$ in. long, in the horizontal side of the clamp.

Moving Traction Motors to the Shop

With the increased use of Diesel-electric motive power on the Chicago, Burlington & Quincy and the desirability of concentrating electric traction motor repair work at a single point where it can be efficiently done, this road has made arrangements to convert two old baggage cars, one of which is illustrated, for special use in hauling traction motors and other company material between the 14th street (Chicago) passenger yard and the system repair shop at West Burlington, Iowa. Other points, such as the new Clyde Diesel locomotive servicing shop of the Burlington at Chicago will also undoubtedly be served by these cars.

One of two C. B. & Q. baggage cars which have been supplied with special equipment for shipping Diesel-electric locomotive traction motors

Conversion work on the baggage cars designed for handling traction motors includes opening one end of the car which is accomplished by setting the end-collision posts out toward the side of the car about 20 in., bracing the top of the opening with a steel beam and applying a projecting box-section cross member to engage the top of the diaphragm face plate of an adjoining coupled car. No closure of any kind is required or supplied for this end-door opening.

The traction-motor-handling car is equipped with an overhead 6-in. H-beam extending the full length of the car and supported from the car floor by 6-in. channels carried up on each side and arched over at the clerestory. The H-beam is equipped with a three-ton chain hoist and trolley to handle heavy parts.

On the car floor, two 56-lb. rails are laid to standard track gage and designed to carry the four-wheel roller-bearing dolly, illustrated, which is equipped with standard motor-car wheels and has a $\frac{1}{4}$-in. steel platform depressed about 6 in. by offsetting the axles downward, as illustrated. This design is necessary to give maximum overhead clearance.

Two 10-ft. end sections of the 56-lb. rails are slidingly supported on the car floor so that they may be pulled out of the end of the car six feet to permit loading and unloading traction motors by means of an overhead crane or crane-equipped truck. When these rail ends are pulled out of the car, two 6-ft. sections are available and used to fill in the gap inside so that the rails will extend without break and permit operating the dolly the full length of the car.

The outer ends of the rail extensions are firmly held to the proper gage by means of a spreader bar across the top. For outboard supports two vertical 2-in. pipe sections are designed to rest on the track rails at the bottom and to engage the 56-lb. rails at the top. These outboard pipe supports are not vertical in the illustration because the concrete floor prevents the saddles on the lower ends of the pipes from slipping down over the rail heads as intended and generally possible.

Traction motors, loaded on this dolly one at a time by the shop crane, are then rolled into the car, set on the car floor and blocked against movement by two-by-fours.

These cars may also be used for the shipment of mounted car wheels or other heavy company materials, if necessary.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Welding Cylinders

Q.—When repairing old cast-iron cylinders by welding, should the weld be made with a cast-iron filler rod or should the crack be brazed?—A. F. G.

A.—Either method can be used. When repairing cast-iron cylinders with the oxyacetylene method, using cast-iron filler rod, extreme care should be taken in the prepa-

ration of the damaged cylinder, particularly in the preheating, in order to get equal expansion.

Welding with the cast-iron filler rod requires skilled operators because the location of the fractures frequently requires vertical welding and sometimes overhead welding. It is also necessary to preheat cylinders to a reasonably high temperature and extreme care is necessary to allow the cylinders to cool slowly in order to secure proper contraction. With brazing (or bronze welding) the cracks are prepared in approximately the same manner as with the cast-iron filler rod, except that the area adjacent to the fracture is cleaned in order to secure good adhesion of the bronze. Due to the ductility of the bronze, it is not necessary to preheat the cylinder casting beyond a normally low temperature to get proper expansion and it is not necessary to construct elaborate brick furnaces for preheating purposes. The general practice is to construct baskets of wire netting to retain charcoal fire and asbestos paper is used to cover the cylinder to prevent cooal air striking the welded area. Of the two methods brazing is more simple and less expensive.

Effect of Thermic Syphons on Staybolt Breakages

Q.—Has any comparison been made of staybolt breakages between locomotives equipped with Thermic Syphons and locomotives without Thermic Syphons? E. F. M.

A.—The official proceedings of the Master Boiler Makers' Association give the following comparisons as to the performances of Syphon and non-Syphon engines with respect to staybolt breakages. "Perhaps the most accurate record of staybolt performance began in 1924 when ten new Santa Fe type locomotives were placed in service, five with thermic Syphons and five without. For several years, the railroad maintained a detailed record of staybolt failures on these locomotives. During a period of 28 months there was a total of 358 staybolts renewed on account of breakages on the five non-Syphon locomotives in addition to a complete renewal of staybolts and radial stays in all of these five locomotives. During the same period there were only 28 broken staybolts on the five locomotives equipped with Syphons. There was no complete renewal of staybolts and radial stays on the locomotives with Thermic Syphons.

"Another comparison between four Syphon and four non-Syphon locomotives illustrates staybolt and radial renewals for one year because of breakage. On the non-Syphon locomotives the total was 284 bolts, while on the Syphon locomotives there were 57 bolts broken. The following year the record for the same locomotives shows non-Syphon locomotives required the renewal of 238 bolts while 60 bolts were renewed on the Syphon-equipped locomotives.

"Another report indicates that, up to and including the year 1928, 15 Syphon-equipped locomotives broke 327 staybolts and radials with an average of 17,886 miles per broken bolt, while 65 non-Syphon locomotives broke 4,004 bolts with an average of 4,060 miles per broken bolt, or over four times as many miles per broken bolt on the Syphon locomotives. This statement was made of locomotives of the same class and in the same service, operating on the same division for an equal period of time."

Ash-Pan Air Opening

Q.—What is the required amount of air opening for the ash pan of a Mikado-type locomotive? Does insufficient air or excess air passing through the grates cause smoke? E. A. D.

A.—The general practice for road locomotives is to make the unobstructed air opening in the ash pan equivalent to 14 per cent of the total grate area, but in no case less than 100 per cent of the total internal tube and flue area. Restricting the flow of air passing through the fuel bed, rather than through the grates, is generally the cause of smoke. Heavy charges of coal restrict the air flow through the fuel bed, causing the gases on the surface of the fuel bed to develop soot because of the temporary reducing atmosphere and the surrounding high temperature. Soot is produced by high temperature and lack of air, and once it is formed it passes through the combustion space without burning and goes out the stack as smoke.

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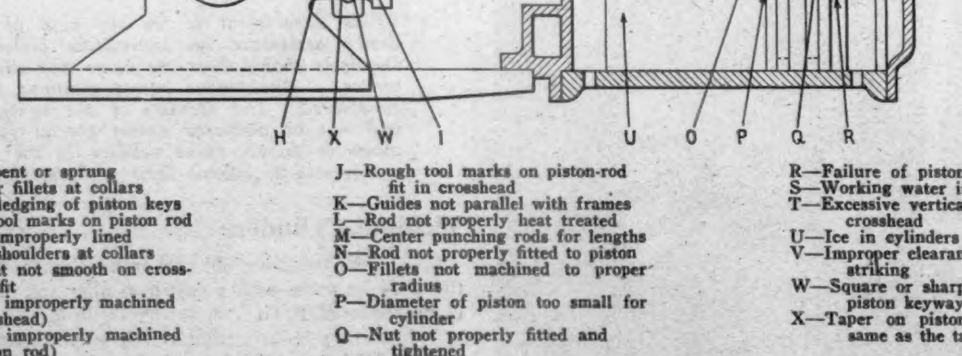
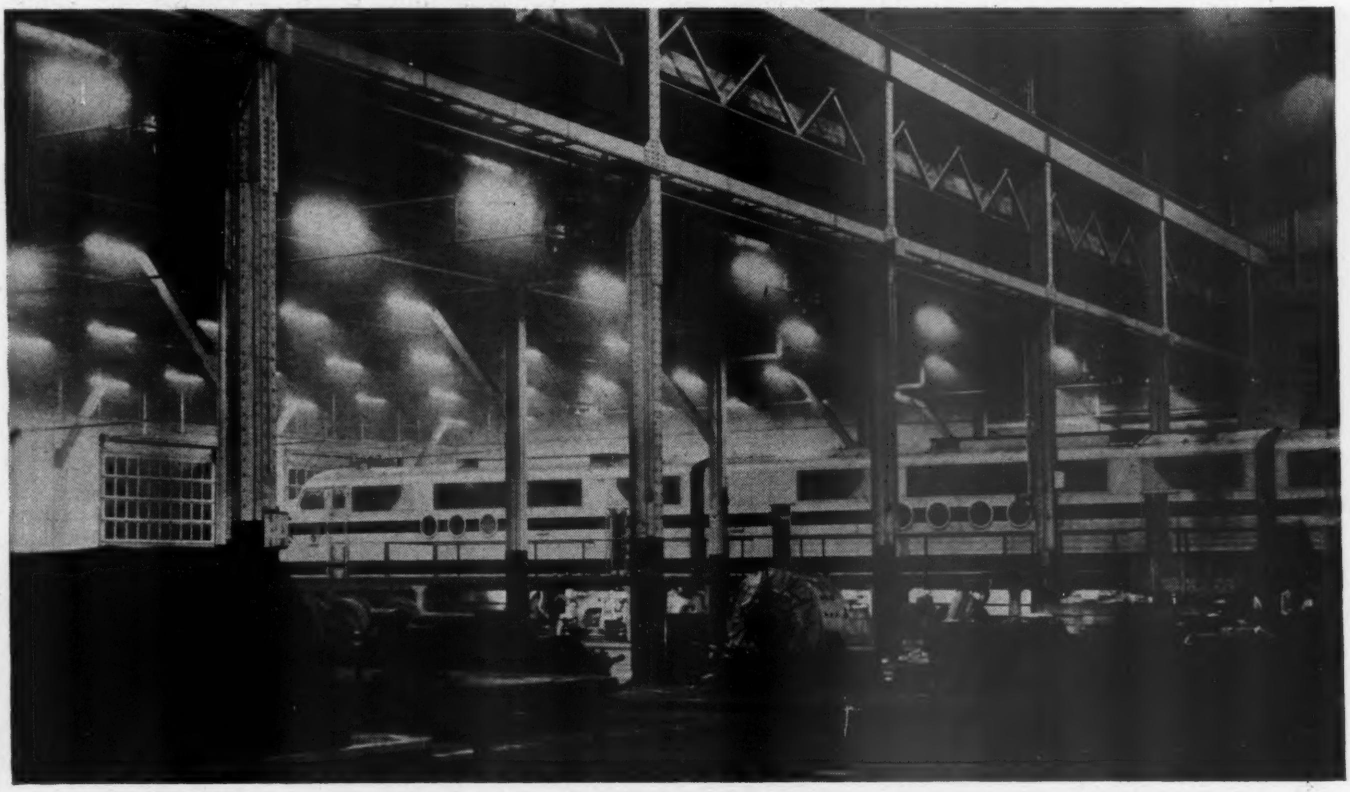


A—Guides bent or sprung
B—Improper fillets at collars
C—Heavy sledging of piston keys
D—Rough tool marks on piston rod
E—Guides improperly lined
F—Square shoulders at collars
G—Piston fit not smooth on crosshead fit
H—Keyway improperly machined (crosshead)
I—Keyway improperly machined (piston rod)
J—Rough tool marks on piston-rod fit in crosshead
K—Guides not parallel with frames
L—Rod not properly heat treated
M—Center punching rods for lengths
N—Rod not properly fitted to piston
O—Fillets not machined to proper radius
P—Diameter of piston too small for cylinder
Q—Nut not properly fitted and tightened
R—Failure of piston-rod nuts
S—Working water in cylinder
T—Excessive vertical wear in crosshead
U—Ice in cylinders
V—Improper clearance: piston striking
W—Square or sharp edges around piston keyways
X—Taper on piston key not the same as the taper in the rod

Defect chart for pistons, rods and crossheads

ELECTRICAL SECTION



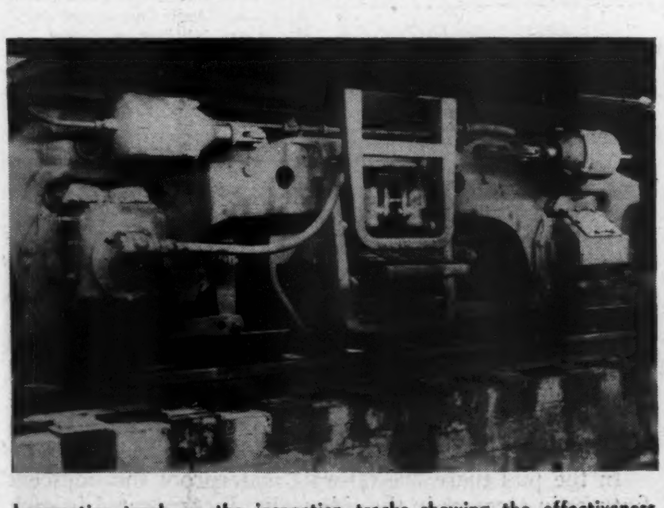
The low-bay fluorescent-lighted section of the shop—Two of the high-bay lighting units may be seen upper right

Light and Power for

The Diesel Locomotive Shop

Lackawanna employs fluorescent units to excellent advantage for under-platform and low-bay lighting—Incandescent lamps are used for the high-bay and for pit side lights

THE Diesel-electric shop of the Delaware, Lackawanna and Western at Scranton, Pa., is designed for locomotive inspection, cleaning, lubricating and the making of repairs including engine and truck overhaul. Available also are facilities for all electrical maintenance except rewinding. Electrical power is used for machine tools, cranes, hoists, door openers and unit heaters, and outlets are conveniently available for portable tools and lights. Fueling and sanding are done on outside tracks.



Locomotive truck on the inspection tracks showing the effectiveness of the under-platform lighting

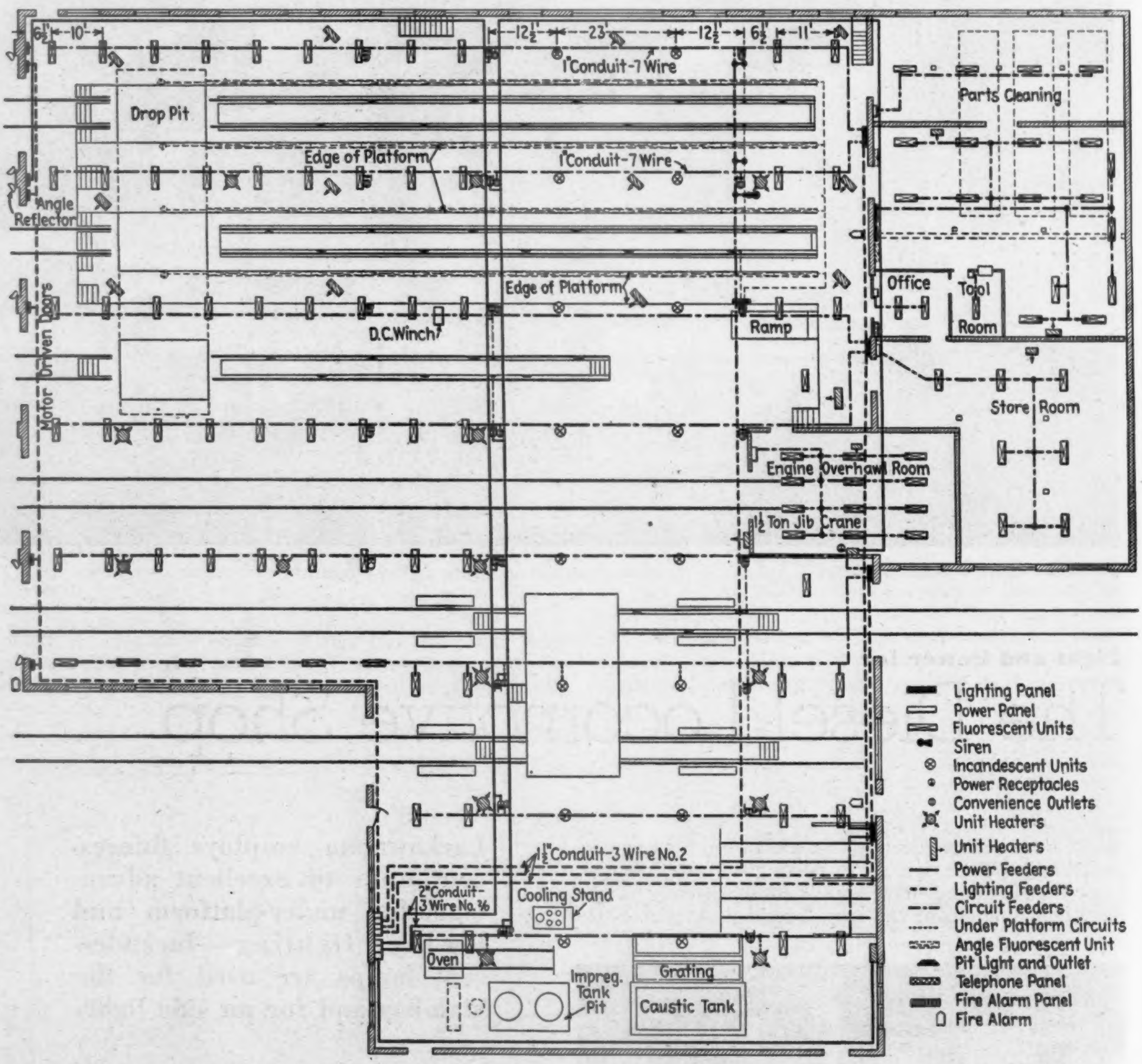
There are two shop inspection tracks and four repair tracks as shown in the plan drawing. All tracks are at ground level, but the floor in the inspection track area is depressed 2 ft. 6 in. and there is a 4-ft. pit between the rails of the inspection tracks. There are also deck-level platforms in the inspection track area on either side and between the tracks. Electrical repair facilities are located

in the end of the high-bay section opposite the inspection tracks. This bay is served by a 25-ton overhead traveling crane.

A section of the building, called the service building, at the end of the inspection tracks and at the level of the raised platform includes a parts cleaning shop, office, tool room and storeroom. In the basement below the parts cleaning room, there are two rooms, one for lubricating oil refining and the other for oil storage. The engine overhaul room, which is in line with track No. 4, as shown on

is 22 ft. above the floor and the units are placed at 10-ft. intervals in rows 24 ft. apart. The units are mounted on beams where the location of the beams coincides with the required position of the lights and are otherwise suspended on messenger cables. This makes an inexpensive means of placing them exactly where they are wanted. With the units in average service condition, illumination on the horizontal plane varies from 6 to 7 footcandles.

Lighting under the deck-level platforms between the inspection tracks is especially effective. It is accomplished



Plan of the shop showing lights and power outlets

the diagram, is at the level of the shop floor or ground level.

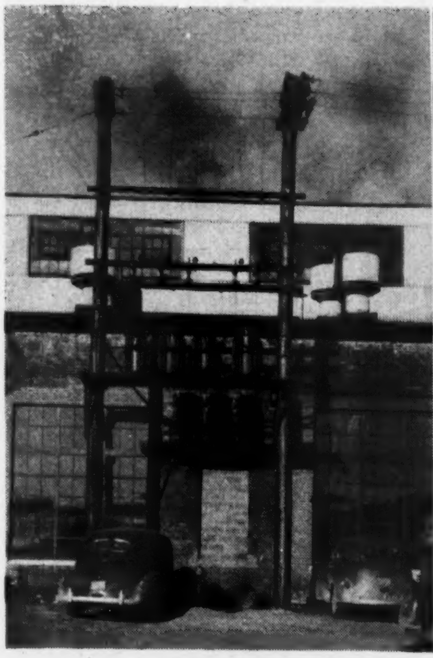
Lighting

Lighting for all shop facilities is accomplished with 172 fluorescent fixtures, each containing two or three 40-watt lamps and 72 incandescent fixtures ranging in size from 60 to 1,000 watts.

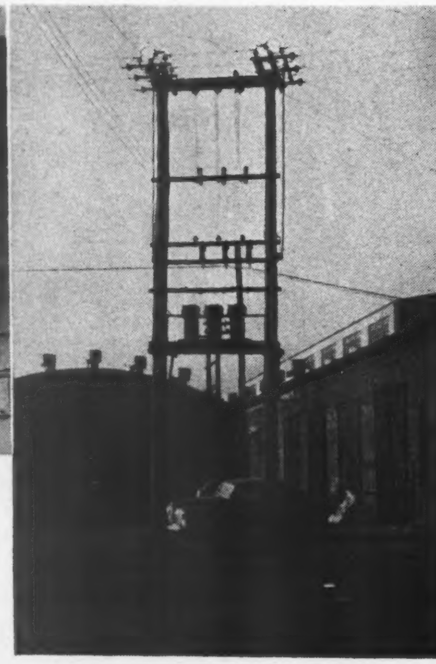
Enameled, industrial type fluorescent fixtures, each containing three 40-watt lamps, are used in the low-bay section of the main shop, in the office, the engine overhaul room and the storeroom. In the shop the mounting height

by practically continuous lines of 8-ft. angle type fixtures placed under the edges of the platforms with the light directed toward the running gear of the locomotives. A total of 56 fixtures, each containing two 40-watt lamps placed end to end, are used for this purpose. Illumination intensities on the running gear exceed 20 footcandles and the lighting permits the performance of all normal running gear maintenance without the use of portable extensions.

In the pits there are 60-watt waterproof incandescent fixtures in recesses in the side walls. Incorporated in each fixture is a receptacle for a portable extension.



Lighting control station



Left: The transformer station—Right: Junction poles showing power supply lines coming from right and left and the 15-kva. transformers for the fuel oil pumping station—The Diesel shop in the background

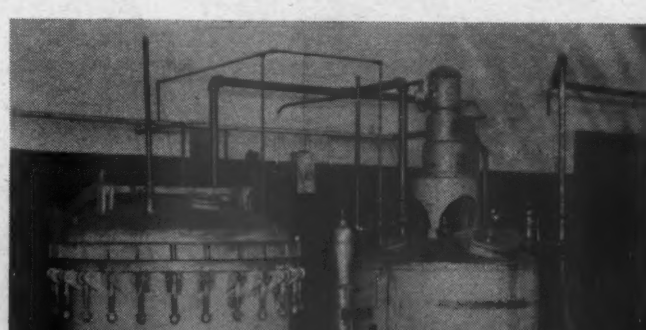
Under-platform lighting and pit lights

The high-bay section which extends through the center of the shop is served by a 25-ton crane and is lighted by sixteen 1,000-watt incandescent lamps in high-bay shallow-bowl reflectors, mounted 40 ft. above the floor on 23-ft. centers. Under service conditions, the lighting intensity on the horizontal plane is from 6 to 7 footcandles.

At the entrance of the shop, on the parapet of the building, there are six 500-watt standard angle reflectors for lighting the approach track area. Vapor-proof fluorescent lamps are used in the lubricating oil refining room and in the parts cleaning room.

Power Load

The connected power load in the shop includes a 30-kw. baking oven employing a 1½-hp. motor, a 3-hp. motor driving the vacuum pump for the impregnator, a 5-hp. exhaust fan motor for the cleaning and painting booths, a 20-hp. and a ¾-hp. motors for the drop pit table, two

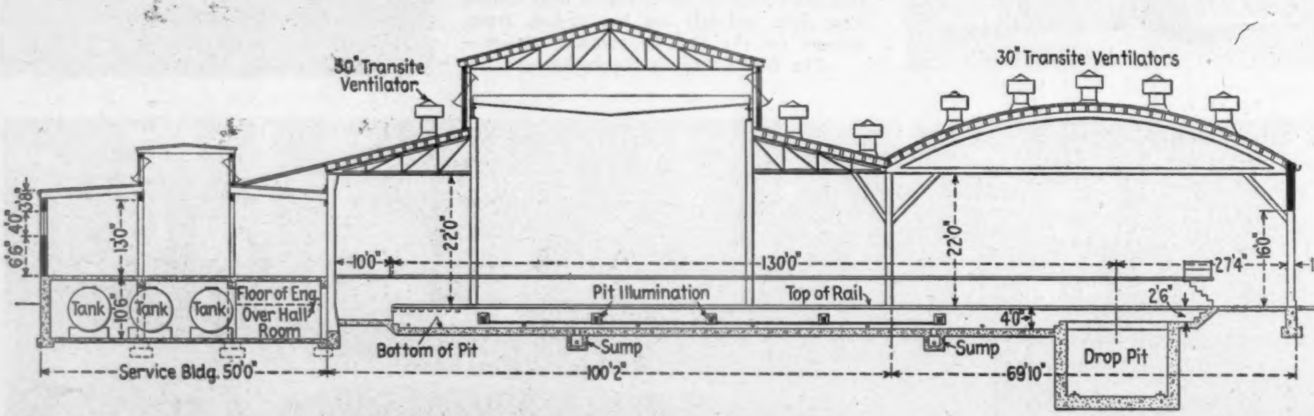


Vacuum impregnating equipment

Oil refining room showing exhaust hood and duct

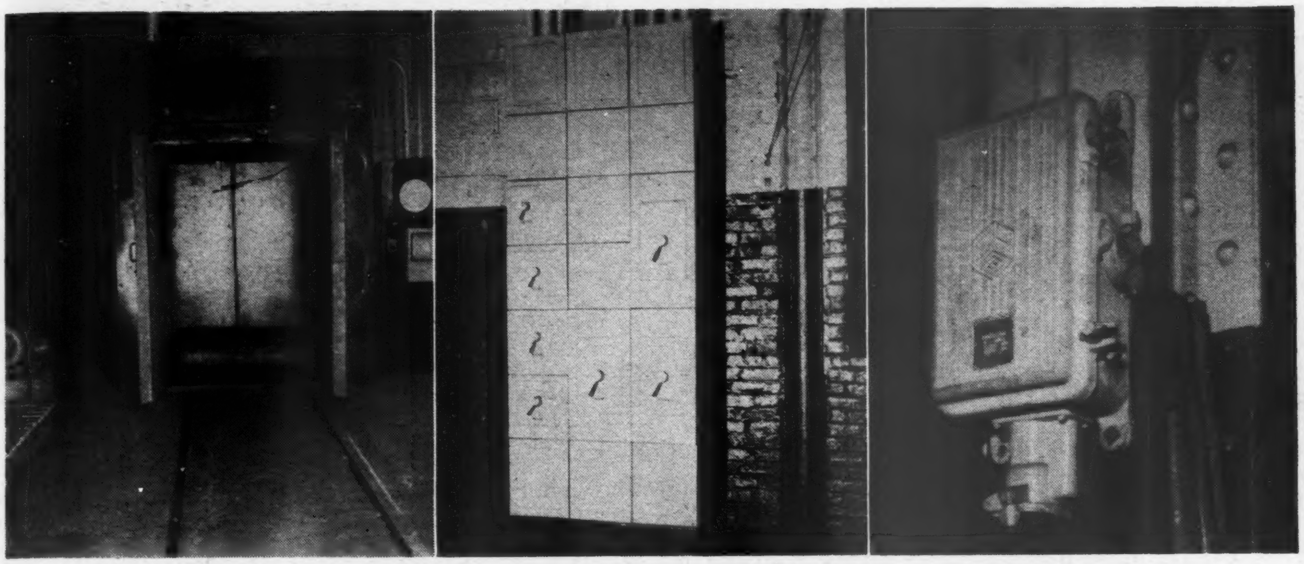
½-hp. door opener motors, fourteen 1/6-hp. overhead unit heater motors controlled by thermostats, eighteen 1/12-hp. wall type heater motors, a 1-hp. a.c. crane motor in the parts cleaning room and also in the engine overhaul room, a ¼-hp. motor driving a valve grinder, two 3-hp. oil pump motors, one 1-hp. filter press motor, one 3-hp. exhaust fan motor, one ¾-hp. agitator motor and four 6-kw. immersion heaters in the oil refining room. There are also five d.c. motors receiving power from 250-volt d.c. feeders. These are a 7-hp., two 31 ½-hp., and a 15-hp. for operating the 25-ton crane and a 3-hp. car pulling winch motor.

The oil pumps in the oil refining room are used respectively to pump oil from the crank cases of engines to the refining tank or to drainage oil storage tank, and to pump either refined or new oil from storage tanks to the pressure tank which serves the locomotives. During the process of refining the oil a considerable amount of oil vapor is formed and this is removed through a hood and duct by a roof exhauster similar to those used for drafting



Elevation of the shop from the inspection-track end

The high-bay section as seen from the crane



Left: The baking oven—Center: Main Control Center—Right: Column-mounted power outlet

locomotives. The motor runs at either 1,800 or 3,600 r.p.m.

The wall type unit heaters are used in the smaller rooms and under the inspection track platforms. Some are controlled manually and some by means of thermostats. In addition to the motor and heater outlets there are nine, 3-phase safety interlocking plug receptacles located at convenient points. Also, on every column in the shop there is a 110-volt, single-phase convenience outlet. There is a total of 40 of these consisting of 10 two-gang and 30 single-gang receptacles.

Power Supply and Distribution

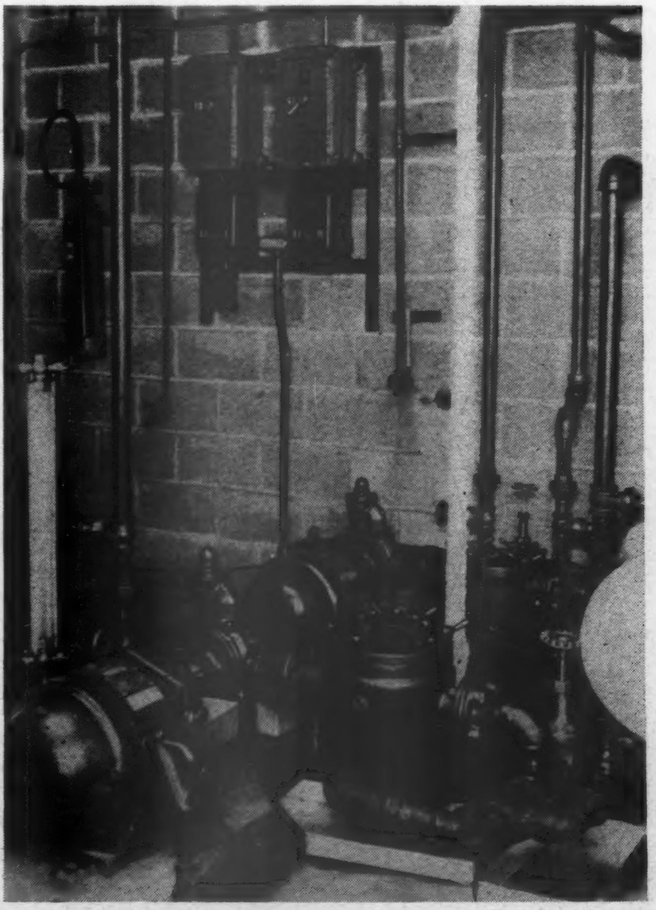
Power is purchased at 4,150 volts, 3-phase and 60 cycles and is taken from three sources to insure continuity. The 4,150-volt lines come from two directions to a junction pole structure about 160 ft. from the Diesel shop transformers. On this pole structure is a platform supporting three 15-kva. transformers which supply 440-volt, three-phase power for a Diesel fuel oil pumping plant. The oil is pumped from tank cars to a storage tank and from the storage tank to the fuel tanks of the locomotives. When a locomotive is spotted for fueling, the pumps are started by remote control, the excess oil not delivered to the locomotive being returned to the suction line through a valve and by-pass.

From the junction pole, the overhead 4,150-volt lines are run to a transformer station which supplies the shop. It consists of two wood poles set 14-ft. apart between which is a platform 24-ft. above the ground. On the platform, are three 37½ kva. power transformers for three-phase, 440-volt power and one 50-kva. transformer for the single-phase 110/220-volt lighting circuits. The transformers are protected and de-energized by outdoor drop-out fuse disconnecting switches with expulsion type fuses.

The secondary circuits are carried into the building in rigid metal conduit to a control center on the inside wall of the building near the transformer station. The control center consists of three steel vertical sections of equal height and depth containing vertical bus bars of 300 amp. capacity into which may be plugged various control units. In this case, they are circuit breakers.

The control units make electrical connection to the bus bars in the vertical sections through the medium of "stabs" mounted on the back of the control units. This assembly allows for almost unlimited flexibility since a unit can be removed and another inserted whenever a change is needed. It is also easy to install and represents a considerable installation cost saving as compared with the mounting of safety switches or angle iron supports. In addition to its flexibility, it has the feature of complete safety. The switches on the left, as shown in the illustration, control four lighting circuits. Three are 110-amp. breakers and one is a 35-amp. breaker. Those on the right are three power circuits. They are 225-amp. breakers. There are no fuses in any circuit.

All inside wiring consists of rubber-covered wire in rigid metal conduit. Steel cabinets are used at all important junction points, a total of 85 being used for this purpose. They provide a convenient means of rearranging or adding to circuits to meet future demands.



Lubricating-oil pumps

Is 15 Footcandles the Upper Limit for Passenger Cars?

The opinion is widely accepted that there is too much light in a passenger car when the illumination values exceed 15 footcandles. Is this a definite or desired limitation? If not a definite limitation, how can it be removed?

Too Much Light

When someone says there is "too much light" they simply fail to complete the statement. The complete statement should read "There is too much light *out of place.*"

The annual average natural illumination level for New York City is 3,500 footcandles. It cannot therefore be argued that such low levels as 15 footcandles represent a natural or physiological limit.

There are artificial factors at work that limit practical lighting levels in railroad cars. These are:

(1) The limited amount of power available in a railroad car which sets a ceiling on the lighting level.

(2) The limitations imposed by the types of lighting equipment available, which result in still lower levels than the power ceiling.

(3) The limitation set by the manner of decorating the car interior, which drops the comfortable lighting level lower still.

Comfort is the product of the *distribution,* rather than the *amount* of light in the field of view, as long as the amount is above the threshold. The eye is extremely sensitive to the manner in which the light comes to the eyes from the different parts of the field of view, and assuming a moderate, but adequate amount of light to start with, the *distribution* of the light becomes the most important feature in designing a lighting system.

Natural lighting is so comfortable because of the manner in which natural light is distributed in the natural field of view. The field of view in a passenger coach is shown in Fig. 1. This field of view is divided up into zones in a manner based on a long series of experiments made with natural lighting. Tests and experience show that there are definite relative values of brightness which the eye will tolerate without strain in these several zones. Brightness values have been determined by actual measurement of comfortable fields of view. The optimum range of variations in the distribution of light in the natural field of view is approximately shown in Fig. 2.

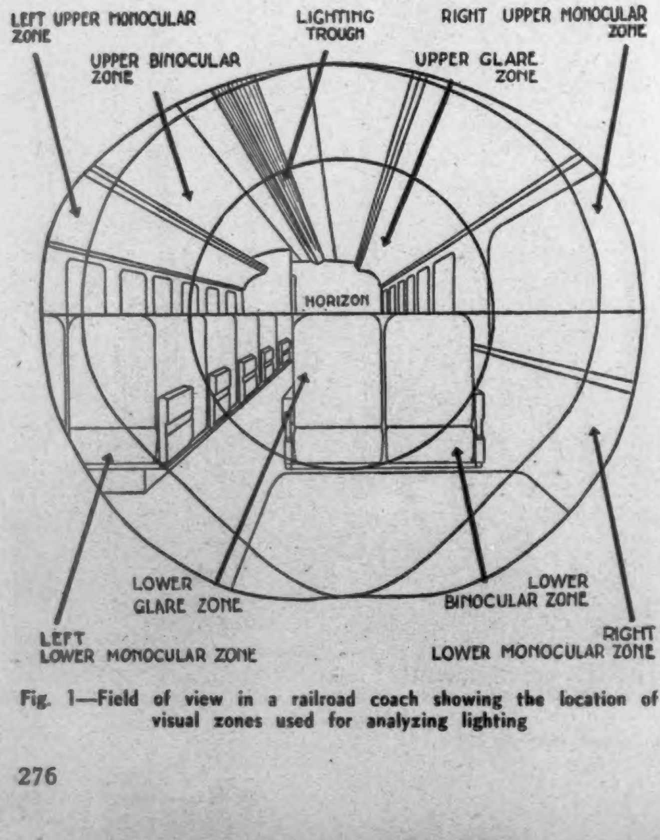


Fig. 1—Field of view in a railroad coach showing the location of visual zones used for analyzing lighting

Can you answer the following question? Answers should be addressed: Electrical Editor, *Railway Mechanical Engineer*, 30 Church Street, New York 7.

Is it practical to correct depreciation caused by moist operating conditions with the apparatus in place? This is particularly desirable for motors or other equipment which must stand idle for long periods.

The two heavy lines that cross this diagram can be considered guide lines in the design of artificial lighting systems.

When distribution of light in an artificial system falls between these lines, comfortable and efficient visual conditions may be predicted because it will be a distribution within the optimum range of human adaptation.

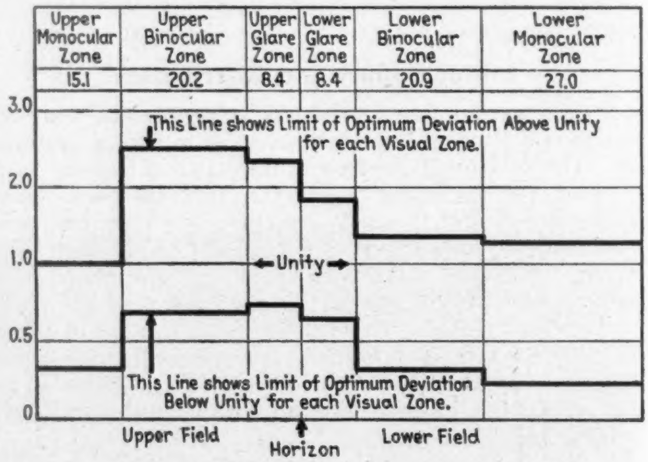


Fig. 2—Flux analysis chart of natural lighting showing the optimum range of variations for visibility and comfort

The application of this principle to the lighting of a railroad car can be illustrated as follows:—Either from the actual car, the car mock-up, or the designer's drawings, a perspective is prepared showing what would be included in the field of view of a passenger sitting near the center of the car, in an aisle seat. Such a perspective is shown in outline in Fig. 1, with the important visual zones indicated.

Let us assume that the lighting equipment of this coach is to be a continuous fluorescent unit, attached to the ceiling and running the length of the car: with a plastic, diffusing cover concealing the twin row of 40-watt fluorescent lamps that a preliminary computation has shown will be necessary to produce 25-30 footcandles on the test reading plane over each seat. Let us assume that finishes now in general use will be used, and securing samples of the actual finishes, let us measure their reflection factors.

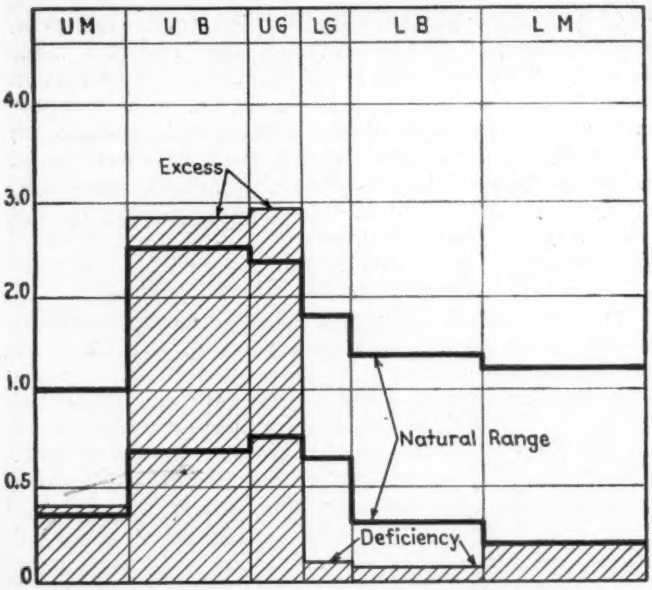


Fig. 3—Flux analysis chart of railroad coach lighting with two rows of 40-watt "F." lamps continuous in plastic envelope

Armed with this information, and knowing the photometric distribution of a lighting unit of the type described, the brightness of each part of the coach interior can be determined as it will appear to the passenger. From that the light that will reach the passenger's eyes from each part of his field of view can be computed.

These two steps can be rolled into one if there is a mock-up of the car available because then a fluxmeter can be used to directly read the light that is reaching the passenger's eyes from each visual zone. The next step is to draw the flux diagram, on the basis of the preceding computations, or the measurements.

The flux diagram, for the car we have selected as an example, is shown in Fig. 3.

There would be an *excess* of light in the upper half of the glare zone, and binocular zone (refer to Fig. 1 for the location of these zones in the field of view of the passenger); and there would be a *deficiency* in the lower half of the glare and binocular zones. This deficiency would occur despite the fact that the reading zone, in which there would be from 25 to 30 footcandles, is located in the lower half of the glare zone. In short, if the excess in the upper glare and binocular zones, which is caused by the lighting fixture traversing these zones, is to remain, the illumination level should be raised to 150 footcandles, in order to eliminate the deficiency in the lower zones. This is another way of saying that the lighting fixture would become comfortable in a field of view having an illumination level of 150 footcandles, all other things remaining equal.

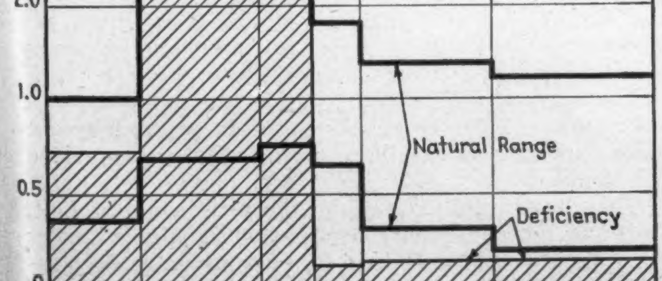


Fig. 4—Flux analysis chart of railroad coach lighting with one row of 40-watt "F." lamps continuous over Holophane Controlenses

This solution is out of the question. What corrective is possible? Lenses or louvers might be used to replace the plastic envelope, the former to *control* the distribution of the light, permitting *less* to go into the upper part of the car by bending the excess into the lower part, and thus raising the illumination level at the same time as the brightness level of the light source is being reduced; the latter to shield the eyes from the light source.

The louvers were rejected in favor of the lenses in the example being discussed, as the illumination gain from

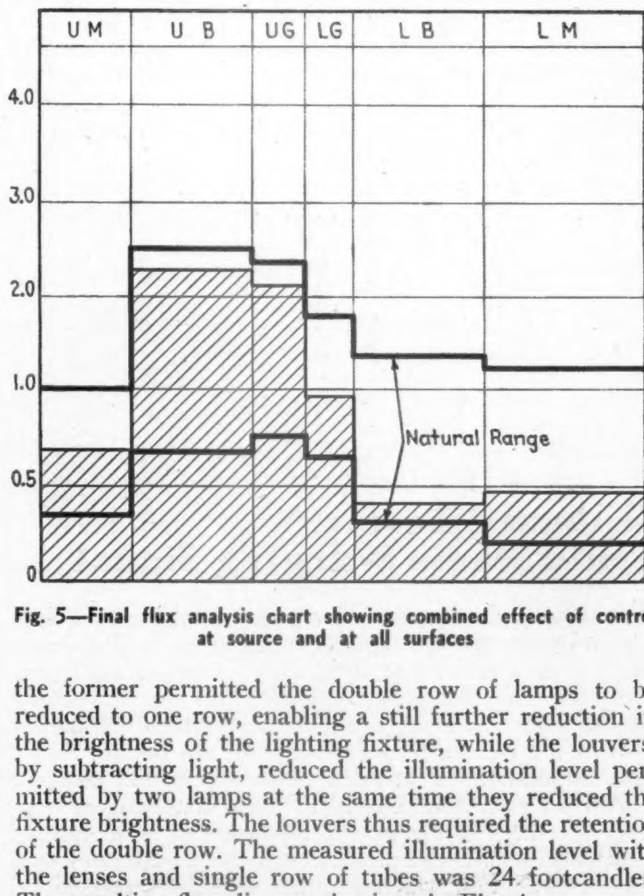


Fig. 5—Final flux analysis chart showing combined effect of control at source and at all surfaces

the former permitted the double row of lamps to be reduced to one row, enabling a still further reduction in the brightness of the lighting fixture, while the louvers, by subtracting light, reduced the illumination level permitted by two lamps at the same time they reduced the fixture brightness. The louvers thus required the retention of the double row. The measured illumination level with the lenses and single row of tubes was 24 footcandles. The resulting flux diagram is given in Fig. 4.

It shows considerable improvement. However, it is not the whole answer. Too much light would still come from the upper part of the car and not enough from the lower part. Although by using a lens designed to bend the light *laterally* towards the seats, some of the excess light has been removed from the upper part of the car, there is still too much light moving *lengthwise* of the car from the lighting trough. This "out of place" light could be taken care of by adding an optical element to the lens which would turn the lengthwise light down at steeper angles so that it would reach the lower part of the car at a level below the heads of the passengers. However, as the quantity of light involved was smaller than the amount already taken care of by substituting the lens for the plastic, it was obvious that some additional step was necessary.

Practically all the light that could be put into the lower part of the car was now being put there, and yet the lower part of the car was not returning sufficient light to the eyes, in proportion to the distribution of the light in the rest of the passenger's field of view. The final step was,

therefore, to return more light to the eyes from the lower part of the car by using lighter finishes.

An inspection of Fig. 4 shows that four times as much light is needed from the lower glare zone. Reference to Fig. 1 shows this zone to be occupied by the seats and center aisle; so the seat backs, sides, and floor of center aisle needed a reflection factor four times greater than they had. This would not be difficult as these areas are traditionally given low reflecting finishes (from 2 to 10 per cent). The lower binocular zone needed doubling, which simply added the car wall to the preceding areas, and so its reflection factor should be doubled.

A new and final analysis was then made which is given in Fig. 5.

The flux line at last *falls between the natural lines* and so we could be reasonably confident that seeing in a coach so lighted and decorated would be sensibly as safe, pleasant and easy as under natural conditions.

The preceding example shows that the distribution of light in the field of view can be brought within the natural guide lines on the flux chart when proper selection of reflection factors is added to light distribution control.

To summarize, higher illumination levels with comfort in railroad cars require that the light be controlled *as it leaves the lighting equipment*; and that it be controlled as it is reflected from all surfaces in the field of view, by a scientific choice of reflection factors.

H. L. Logan,
Engineer-Consultant,
Holophane Company, Inc.,
New York 17, N. Y.

Seaboard Tests Train Radio Warning Signal

The Seaboard Air Line has recently completed the first road tests of the new radio device known as slow tone, which is designed to send a warning to approaching trains when any train has been stopped under unusual circumstances. This new slow-tone equipment, which was developed by the Bendix Radio Division of the Bendix Aviation Corporation, is intended as an adjunct on sections of railroad where radio telephone train communication is being installed on the locomotives used on road trains. When a train makes an unusual stop, the engineman operates a push-button which causes a device to broadcast a special high-frequency slow tone in the form of a series of high-pitched notes that will be received and reproduced in the loudspeakers on the locomotives of other trains within a range of several miles.

If the engineman is using his radio in conversation with some other party, he can readily recognize the slow tone in contrast to voice. In either instance, as soon as he hears the slow tone, this is a warning to him to get his train under control and reduce speed prepared to stop short of obstruction within range of vision. At the same time, he can use his radio telephone to listen in on any statements being broadcast from the engineman of the train that has been stopped, to explain the location of that train, the cause for the stop, and the probable duration. With this information, other enginemen can stop their trains or proceed accordingly.

The new device is not intended to replace any safety equipment or practices now used on the railroad but rather to supplement existing measures. The slow-tone warning is, in effect, a form of additional long range flagging that is established instantly. During the last year, the Seaboard, as well as numerous other railroads, made extensive tests of radio telephone train communication made by the Bendix Corporation, but this slow-tone protection is a new adjunct first announced by Bendix on December 18, 1945, and the first road tests were made on the Seaboard, between Atlanta, Ga., and Birmingham, Ala., March 26, 27 and 28. The radio apparatus, for the train telephone and slow-tone warning, operates at very-high-frequency on a wave length assigned for test purposes by the Federal Communications Commission.

The train-to-train tests of the radio communication system, including the slow-tone warning, were made in the vicinity of Rockmart, Ga., where the terrain is rough, and there are heavy grades, deep cuts and numerous curves, with extensive heavily wooded sections near the tracks. All these conditions are adverse to the use of radio.

With the slow-tone warning being broadcast from one locomotive and the other train approaching, the first distinctive warning was heard at a distance of about 12 miles. Under extremely adverse conditions in deep cuts, at ranges of 12 miles down to about 3 miles, the slow-tone would fade, or might be "spotty." A conservative statement is that at distances of about 2 miles the slow-tone gave adequate warning, even under all circumstances. Thus the tests indicated that under the worst conditions encountered, an engineman would receive the warning in plenty of time to stop his train short of any train stopped ahead. In general, the slow-tone warning was heard from one to three miles further than conversation along the same route. Fading in dead spots was less extensive in the slow-tone than in voice communication.

Cab of one of the locomotives used for making slow-tone tests

Although these test runs were made primarily to test the slow-tone warning feature, tests were made also of the radio telephone communication between trains, between trains and a fixed station in Atlanta, and between the front and rear of each train.

The antenna for the fixed station was mounted on a water tower 150 ft. high. As the train proceeded west from Atlanta, good telephone conversation was provided for 15 miles.

These tests were made under the jurisdiction of J. R. DePriest, superintendent telegraph and signals, and under the direct supervision of John Ryscuck, assistant electronics engineer, Seaboard Air Line Railway, with the cooperation of P. B. Tanner, of the Bendix Radio Division of the Bendix Aviation Corporation.

NEW DEVICES

Wilson Mobile De-Icing Machine

The mobile de-icing machine, shown in the illustrations, has been developed by the Wilson Engineering Corporation, Chicago, in co-operation with the mechanical and engineering departments of the Chicago, Burlington & Quincy. It is designed not only to melt ice and snow from underneath Diesel-electric locomotives and other rolling stock, but to dry off truck and machinery parts so that thorough inspection and necessary repairs may be made promptly.

The machine is designed for installation in pits on narrow gage rails so that it may be moved easily to any desired position from front to rear of the pit. The intake air, which comes in through a wire grill at one end of the machine, is forced through a steam-heating unit by an electric-driven blower fan to adjustable louvers at the other end where the air is delivered upward towards the locomotive trucks or underframe. By turning the louvers, the hot air may be directed upward or to either or both sides of the locomotive or trucks as required.

Steam, electricity, and condensate-return stations are located at a sufficient number of points in the pit walls to avoid the necessity of dragging long lengths of hose and cable from one end of the pit to the othrr.

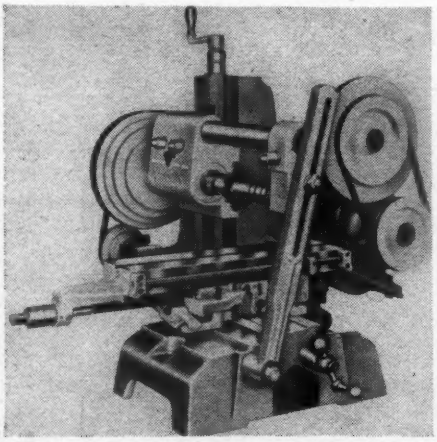
The air-circulating fan in this machine is driven by a 1-hp., a.c. electric motor, operating at 1,150 r.p.m. The fan capacity is 4,200 cu. ft. per min. with all louvers adjusted parallel to air flow. With 100-lb. steam pressure in the heating unit, and a temperature of 60 deg. F., for entering air, the machine will deliver 320,000 B.t.u. per hour and produce a delivering temperature of 131 deg. F.

The control box contains a push-button starter and necessary electrical equipment, including a low-voltage transformer interlocked with a surface-type acquastat to prevent starting the machine until steam pressure is on the line. This limiting control may be shorted out to permit the blowing of unheated air for summertime drying purposes.

Small Milling Machine

An adaptable milling machine which weighs 320 lb. stripped is said to be capable of performing high-speed production work as well as intricate tool work.

Feed speeds are variable in 32 steps from



Small, versatile milling machine

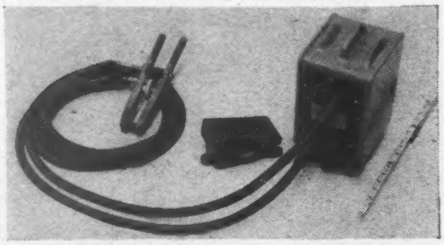
¼ in. to 15 in. per minute, and are available from 0.0015 in. to 0.013 in. per spindle revolution. There are eight spindle speeds which range from 98 to 1,140 r.p.m. through double-belted cast-iron pulleys. A low spindle speed of 33 r.p.m. is provided by the back gear accessory.

The machine has 12-in. longitudinal, 10-in. vertical, and 7-in. cross travel. A heavy-duty vertical attachment converts the horizontal machine into a standard vertical milling machine. A rise-and-fall vertical spindle is used. The horizontal spindle nose has standard lathe threads for operations such as mounting chucks and face plates; it can swing 22 in. Small bar stock can be fed through the taper spindle. Jig boring may be done using rods and indicator.

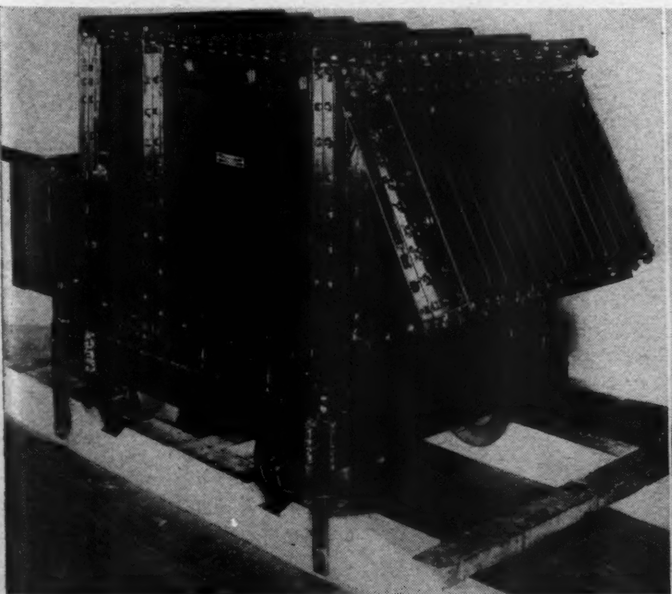
The spindles are equipped with Timken adjustable bearings. The vertical lead screw has ball bearings. Self-lubrication bearings with oil reservoirs are used at other points. The Aircraft Machinery Corporation, Burbank, Calif., manufacturers of the machine, guarantee the lead screws not to exceed 0.0005 in. total accumulated error, and the dovetail movements 0.001 in.

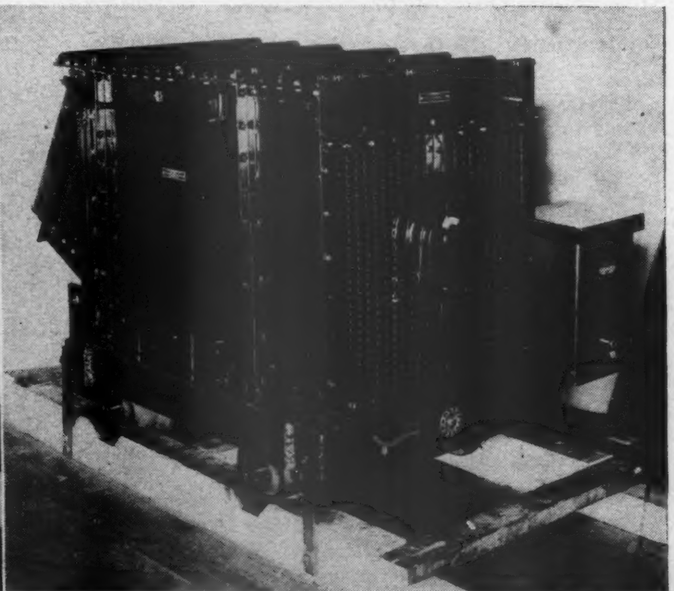
Portable Brazers

A need for portable brazing sets for joining wire cables, strap connectors, pipe, etc., has been met by Westinghouse Electric Corporation, Pittsburgh, Pa., with a self-contained family of brazing sets that require only a connection to a 220-volt power source. The sets consist essentially of a transformer for supplying high currents at low voltage, suitable voltage selectors, controls, and carbon-tipped tongs that



A set consists of a transformer, voltage selector, controls and carbon-tipped tongs





Two views of Wilson mobile de-icing unit designed for use in track pit under Diesel-electric locomotives

can be clamped over the pieces to be joined. The high currents flowing through the carbons bring them to incandescence, quickly raising the material to brazing temperatures, which are from 1,200 to 1,500 deg. F.

Three sizes, 5, 10, and 20 kva., comprise this group of mobile brazing elements. The 5- and the 10-kva. units are air-cooled. The 20-kva. unit is fan-cooled and has a self-contained water cooling and recirculating system used to cool the brazing cables and tongs. This cooling system permits the use of a small-size portable unit for medium brazing work. The three units weigh respectively, 30, 100 and 250 lb. The corresponding secondary currents are 625, 833, and 1,667 amp.

Caboose Power Unit

D. W. Onan & Sons, 43 Royalston Avenue, Minneapolis, Minn., has announced a gasoline-engine-driven generator set for use on cabooses to provide power required in train communication systems. The machine can be mounted in a sheet-metal housing under a caboose, from which it can be slid

Generator set for train-communication systems on cabooses

out on a rack to permit inspection and servicing.

The machine develops 1,500 watts, 115 volts, 60-cycle alternating current, and is specially shielded against radio interference. The two-cylinder, air-cooled, four-cycle engine, has 2¼-in. stroke and 2¾-in. bore, with a compression ratio of 6.3:1.

The set is designed to operate continuously while a train is on the road between terminals. It will carry the requirements for power to the train-communication system, as well as feed electric lamps in the caboose.

Cleaning and Decarbonizing Compound

Developed during the war for cleaning combat aircraft engine parts, Magnus 755 is said to have reduced the cleaning time by 75 per cent. This product is now being made available to the civilian market by the Magnus Chemical Company, Garwood, N. J.

For cleaning, four gallons of the agent are used in the five-gallon can. One gallon of water is added on top to act as a seal, and parts are placed in the welded perforated basket and dipped. Satisfactory cleansing action takes place at room temperatures, but considerable time can be saved by heating the solution to 150 deg. F. Gums, sludge, carbon and grease, as well as paint, enamel, and lacquer will be removed.

The compound may be safely used on leather and fiber gaskets, and on any metal. Because most of the deposits are removed

Cleaning agent harmless to leather, fiber and any metal

in the rinse, it has a long life. It should never come in contact with the skin or with rubber. The fire hazard is said to be low.

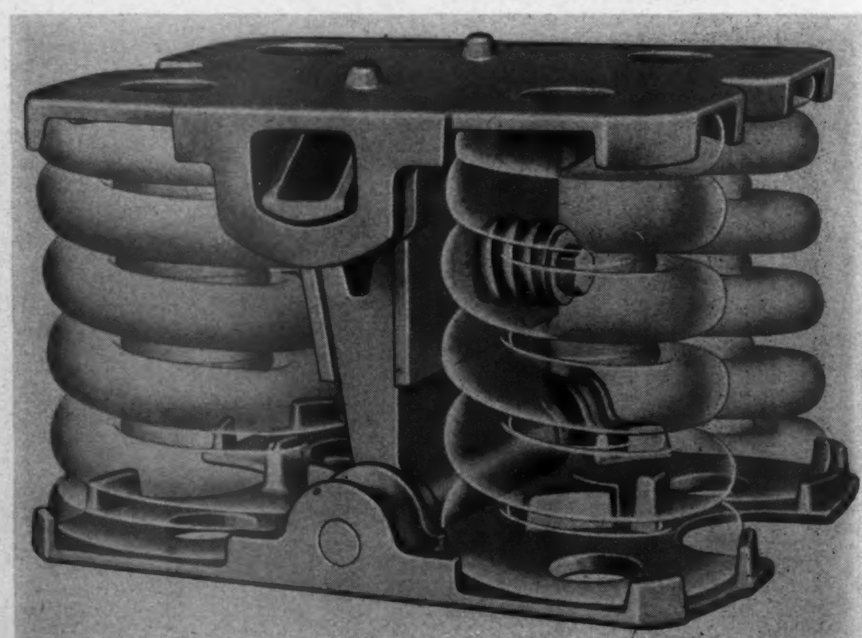
Snub-Up Snubber for Freight Car Trucks

A freight-car truck snubber, recently developed and placed on the market by the Railway Truck Corporation, Chicago, embodies the unique principle of snubbing on the upward instead of the downward stroke and thus enabling road shocks to be cushioned with full and free spring deflection. Damping the rebound tends to prevent bouncing and the build up of harmonic oscillations which cause heavy shocks and damage to equipment, lading and the track structure. The new snubber and nest of four springs are assembled as a complete unit.

The Snub-Up snubber is relatively simple in design with a minimum number of working parts. The top spring plate is connected to two spring-steel wear plates which bear against the sides of a V-shape friction wedge, the thin end of which is trunnioned to the bottom spring plate. Each side of the wedge slopes at an angle of 4 deg. from the vertical and the total area of contact of the two wear plates and wedge is 60 sq. in. The spring-steel wear plates are held against the wedge by two wedge springs and a bolt applied horizontally through the wear plates and wedge. The frictional pressure of the wear plates on the wedge decreases as the springs are compressed and increases on the rebound.

The snubber is designed to take either standard or long-travel truck springs. In addition to controlling truck-spring harmonics on both light and heavy loads, this snubber is said to be an important factor in reducing car maintenance costs.

The general practicability of the Snub-Up snubber design has been demonstrated in severe static and bounce tests conducted at the A. A. R. draft-gear testing laboratory, Purdue University. The device is now being tested in road service on a number of private and railroad-owned freight cars of different types. Some of the snubbers having been in service two years without indications of excessive wear.



Snub-up snubber designed for application with the spring nest as a complete assembled unit in freight-car trucks

NEWS

Dr. Sanford A. Moss Receives Potts Medal

DR. SANFORD A. MOSS of Lynn, Mass., was the recipient of the Potts Gold Medal at the annual Medal Day ceremonies of The Franklin Institute at Philadelphia, Pa., on April 17. Dr. Moss, consulting engineer, General Electric Company, received the award "in consideration of the extreme value of his work in making a turbosupercharger a successful and reliable part of an internal combustion engine."

O. P. A. Suspends Price Control on Rail Equipment

LOCOMOTIVES and tenders, passenger and freight cars and many other types of railroad parts and specialties are included in the transportation equipment on which price control has been suspended, it was announced in Washington, D. C., on April 8 by Paul A. Porter, Price Administrator. This action, he said, carries out our "policy of removing price controls as soon as they are no longer needed to safeguard the country from the disaster of inflation.

"The results of this suspension—price ceilings are only being suspended and not removed—will be under constant scrutiny, partly by means of O. P. A. surveys, and the ability of the industries involved to price their products at reasonable levels will influence the O. P. A.'s future decontrol policy," he added.

Oil and Diesel Engine Industries Aim to Improve Fuel Performance

E. J. SCHWANHAUSSER, president of Diesel Engine Manufacturers Association, has announced that the following men in the Diesel-engine industry will cooperate with a committee from the oil industry in a program aimed to improve fuel performance in Diesel engines: J. W. Linford, American Locomotive Company; C. B. Hoffman, Atlas Imperial Diesel Engine Co.; G. N. Guerasimoff, The Buda Company; Ralph Jackson, Busch-Sulzer Bros.-Diesel Engine Co.; P. L. Callan, Chicago Pneumatic Tool Company; Ralph Boyer, The Cooper-Bessemer Corporation; H. L. Knudsen, Cummins Engine Company, and T. M. Robie and L. D. Thompson, Fairbanks, Morse & Co.

R. C. MacKinnon, Fulton Iron Works Co.; Paul Shirley, General Machinery Corporation; H. M. Gadebusch, Detroit Diesel Engine Division, General Motors Corp.; O. D. Treiber, Hercules Motors Corporation; H. F. Bryan, International Harvester Company, and Walter F. Lathrop, The Lathrop Engine Co.

Earl McMahon, Lister-Blackstone, Inc.; William M. Walworth, Mack Trucks, Inc.; Robert Cramer, Nordberg Manufacturing Co.; Frank Peacock, Sterling Engine Company; J. H. G. McConechy, Sun Shipbuilding and Dry Dock Co., and J. C. Barnaby, Worthington Pump and Machinery Corporation.

The program of research will be conducted by the Automotive Diesel Fuels Division of the Coordinating Fuels Research Committee, which is a part of the Coordinating Research Council. The Council is sustained by the American Petroleum Institute and the Society of Automotive Engineers.

The personnel of the Automotive Diesel Fuels Division is as follows: Dr. D. P. Barnard, Standard Oil Co. (Ind.), chairman; Harold M. Smith, Bureau of Mines; Capt. W. C. Latrobe, U. S. Navy; C. B. Veal, Coordinating Research Council; C. D. Lowry, Jr. and J. S. Bogen, Universal Oil Products Co.; Walter G. Ainsley, Sinclair Refining Co.; John C. Day, Western Petroleum Refiners Association; Comm. Norman H. Hall, U. S. Coast Guard, and Mr. Robie and Mr. Thompson.

Welded Boilers Discussed at A. S. M. E. Spring Meeting

LOCOMOTIVE boilers of welded construction was the subject of a paper presented by James Partington, manager, engineering department, American Locomotive Company, before the Railroad session of the American Society of Mechanical Engineers, during the Spring meeting of the society at the Read House, Chattanooga, Tenn., on April 2, 1946. The chairman for the meeting was C. E. Pond, assistant to superintendent motive power, Norfolk & Western.

Discussions of Mr. Partington's paper, written or oral, were made by A. J. Moses, vice-president and general manager, Hodges-Walsh-Werdner division, Combustion Engineering Company, Inc.; John M. Hall, director, Bureau of Locomotive Inspection, Interstate Commerce Commission; J. G. Adair, mechanical engineer, Bureau of Locomotive Inspection, Interstate Commerce Commission; A. J. Townsend, vice-president, Lima Locomotive Works, Inc.; Ralph Johnson, chief engineer, Baldwin Locomotive Works; J. D. Loftis, general superintendent motive power, Atlantic Coast Line; A. F. Stiglmeier, general supervisor boilers and welding, New York Central; H. B. Oatley, vice-president, Superheater Company; W. M. Barr, research and standards consultant, Union Pacific; H. L. Miller, metallurgist, Republic Steel Corporation; and F. P. Huston, development and research division, International Nickel Company.

1945 Proceedings

THE 1945 Proceedings of the Master Boiler Makers' Association and the Railway Fuel and Traveling Engineers' Association are now available:

Master Boiler Makers' Association. A.

Orders and Inquiries for New Equipment Placed Since the Closing of the April Issue

FREIGHT-CAR ORDERS

Road	No. of locos.	Type of loco.	Builder
Chesapeake & Ohio	50	30-ton caboose	American Car & Fdry.
Northern Pacific	50[1]	Refrigerator (frt.)	Northern Refrig. Lines
Wabash	60	70-ton covered hopper	American Car & Fdry.

FREIGHT-CAR INQUIRIES

Pacific Fruit Express	2,000	40-ton refrigerator
Southern	1,000	50-ton box
	600	50-ton gondola
	100	70-ton gondola
	250	70-ton ballast
	150	70-ton covered hopper

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
Chicago & North Western	12[2]	Sleeping	Pullman-Standard
	4[3]	Dining	American Car & Fdry.
	2[3]	Lunch-counter-dining	American Car & Fdry.
	3[3]	Club-lounge	American Car & Fdry.
	1[3]	Mail-bagg.	American Car & Fdry.
	2[3]	Mail-storage	American Car & Fdry.
	3[3]	Bagg.-dorm.	American Car & Fdry.
	1[3]	Cafe-lounge	American Car & Fdry.
Chicago, Milwaukee, St. Paul & Pacific	6[4]	Mail	Company shops
	6[4]	Bagg.-dorm.	Company shops
	24[4]	Coaches	Company shops
	6[4]	Dining	Company shops
	6[4]	Recreation-lounge	Company shops
	18[4]	Sleeping	Pullman-Standard
	6[4]	Compartment-drawing-room "Beaver Tail" observation-sleeping	Pullman-Standard
Kansas City Southern	8	Sleeping	Pullman-Standard
	2[5]	Dining	American Car & Fdry.

[1] To be constructed at a cost of $500,000.
[2] To be constructed of high-tensile steel at a cost of $1,287,000.
[3] To be of lightweight construction. The 15 cars will cost approximately $1,500,000.
[4] All of the cars will be of lightweight alloy-steel construction and equipped with four-wheel trucks and special "tight" couplers, will be used to equip 6 new lightweight 12-car streamlined trains for operation between Chicago and Tacoma, Wash., and Seattle.
[5] Aluminum construction.

F. Stiglmeier, secretary-treasurer, 29 Parkwood street, Albany, N. Y. Price, $5.

The Railway Fuel and Traveling Engineers' Association. T. Duff Smith, secretary-treasurer, 327 South LaSalle street, Chicago. Price, $3.

Canadian Pacific Shot-Blast Cleaning Plant

CONSTRUCTION of a $300,000 shot-blast cleaning plant, the first of its type on a Canadian railway, is under way at the Canadian Pacific's Angus shops in Montreal. The plant will be completely enclosed for year around operation, and will be equipped with both air-cleaning and ventilating systems, and shot conveyors and cleaners. Before entering the shot-blasting room cars and locomotives will be steam cleaned, stripped of equipment, and dried. After approximately three hours in the blasting room equipment will be given a coat of priming paint before going to the repair shops.

The Canadian Pacific will also construct a new direct steaming plant this year for its Alyth enginehouse at Calgary, Alta. Since the plant will allow the removal of smokestacks from the enginehouse it will permit a reduction in heat loss and elimination of the smoke nuisance. Hot water and steam at 225 lb., will be supplied to the locomotives in the enginehouse, to take them outside for lighting up. The plant, which will burn minus three-eighths "bagdust" coal, will be equipped with chain grate fuel feed, automatic combustion control, forced draft combustion, mechanical fuel conveyors, and a vacuum ash handling system. The boilers will have a hot limesoda feed water treating plant, which will increase washout time to six months.

Equipment Prices

THE following equipment prices are quoted in recent applications or authorizations for Equipment Trust Certificates received or issued by the Interstate Commerce Commission:

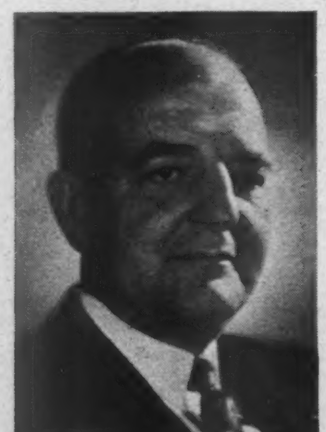
Freight Cars	Each
200 70-ton covered-hopper	$4,355
500 50-ton hopper	2,690
400 70-ton gondola	3,188
200 50-ton hopper	2,725
Passenger Cars	**Each**
2 passenger-baggage-dormintory*	$84,541
3 dining*	98,076
3 tavern-lounge*	96,936
1 passenger-baggage*	96,374
11 coaches*	76,877

* Stainless steel.

Supply Trade Notes

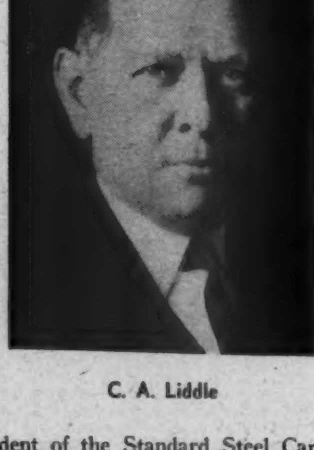
PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—Champ Carry, executive vice-president of the Pullman Company since 1941, has been elected president of the Pullman-Standard Car Manufacturing Company, succeeding *C. A. Liddle,* who has been elected chairman of the board of Pullman-Standard. *Frank B. Baker* has been elected vice-president.

Champ Carry resigned as a director and vice-president of the Pullman Company, the sleeping car operating subsidiary of Pullman, Inc., to accept the presidency and a directorship of Pullman-Standard. Mr. Carry, who will continue to serve as a director of Pullman, Inc., is also a director of the M. W. Kellogg Company, United States Gypsum Company, Cornell Wood Products Company, and the Hummel & Downing Co. During World War I he served as a lieutenant in the 18th Field Artillery, Third Division, and was awarded the Distinguished Service Cross. He was born at Lockport, Ill., on May 31, 1896, and received his higher education at Cornell University. He began his business career in 1919 in the shops of the Haskell & Barker Car Co., at Michigan City, Ind. Two years later he became sales agent, and continued as such with the Pullman Company when it acquired the Haskell & Barker Car Co. in January, 1922. When the Pullman Car & Manufacturing Corp. was formed in 1924, Mr. Carry was appointed sales manager of the new corporation, and in 1929 became vice-president in charge of sales. In April, 1932, he was elected vice-president and assistant to the president of the Pullman Company, the operating subsidiary. On May 15, 1936, he became vice-president in charge of operations, and on January 14, 1941, executive vice-president.



Champ Carry

C. A. Liddle was born at Philadelphia, Pa., on November 14, 1877, and educated at Drexel Institute in that city. From 1894 to 1905, he was draftsman, cost estimator, and chief draftsman for the American Car and Foundry Company, and in 1905 became assistant to the general manager. In 1916 Mr. Liddle was appointed vice-president of the Haskell & Barker Car Co., and in 1922, was elected vice-president of the Pullman Co. In 1924 he became vice-president of the Pullman Car & Manufacturing Corporation, and in 1928, was elected president. Mr. Liddle was also president of the Standard Steel Car Corporation from 1931 to 1935, when it was merged with the Pullman Car & Manufacturing Company to form the present corporation, of which Mr. Liddle became president in 1935.



C. A. Liddle

Frank B. Baker, who has charge of purchases for all plants of the Pullman-Standard Company, began his career in the railroad equipment business in 1912, when he left a position in the shops of the Michigan Central to become record clerk in the Haskell & Barker carbuilding plant at Michigan City, Ind. He rose through several stenographic positions to assistant purchasing agent, and was appointed supply agent at Chicago when Haskell & Barker was merged with the Pullman Car & Manufacturing Co., in 1922. In 1934 Mr. Baker was appointed general purchasing agent of the Pullman-Standard Car Manufacturing Company, with offices in the car works division.

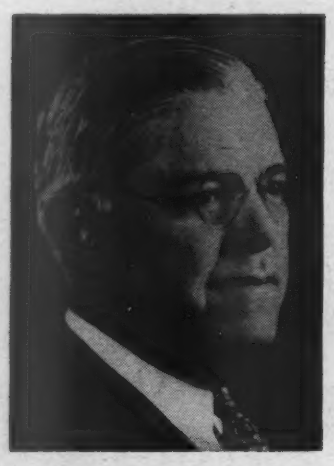
Frank B. Baker

◆

WESTINGHOUSE AIR BRAKE COMPANY; UNION SWITCH AND SIGNAL COMPANY.—*George A. Blackmore* has been re-elected chairman of the board of the Westinghouse Air Brake Company and the Union Switch and Signal Company, Wilmerding, Pa., and *A. N. Williams* has been elected president of the two companies. *S. L. Poorman,* as-

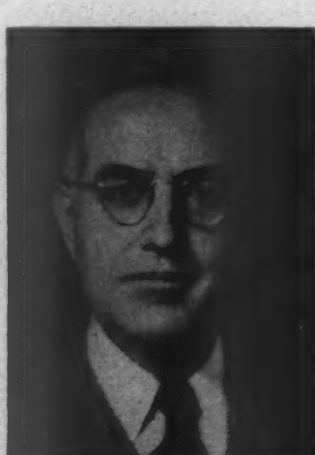
sistant vice-president, has been elected vice-president in charge of sales of the Westinghouse Air Brake Company. *W. C. Landis* has been elected vice-president in charge of manufacturing at Wilmerding and Swissvale, Pa. Mr. Landis had previously been works manager of both plants.

George A. Blackmore, who has more



George A. Blackmore

than 50 years' service with these companies, entered the employ of the Union Switch and Signal Company as an office boy at the age of 12 years. In 1909 he was appointed assistant eastern manager of the company, with headquarters in New York; in 1911, eastern manager, and in 1915 general sales manager at Swissvale. He was elected second vice-president in 1917 and first vice-president and general manager in 1922. He became a director of the company in 1925 and in 1929 was elected president. In 1932 he was elected also vice-president and general manager of the Westinghouse Air Brake Company, and in 1936 became president and director.



A. N. Williams

In 1940 he was elected chairman of the board and president. As chairman, Mr. Blackmore continues to be the chief executive officer of both companies.

A. N. Williams joined the Westinghouse Air Brake Company on February 6, 1945, as a director and was elected vice-chairman of the boards of both the Westinghouse Air Brake Company and The Union Switch and Signal Company on January 1, 1946. Mr. Williams was born in Denver, Colo. He was educated in the public schools of that city and received his higher education in mechanical engineering at Sheffield School, Yale University. He began his railroad career as a rodman on the Denver & Salt Lake and worked on other railroads as a machinist apprentice, brakeman, section-hand and section foreman. From 1917 to 1921 he was construction engineer and operating superintendent of various petroleum industries in Oklahoma, Texas and Mexico. He joined the Midland Valley Railroad as assistant general manager in 1921 and served as general manager from 1922 to 1926. He was general superintendent of the Minneapolis, St. Paul & Sault Ste. Marie from 1927 to 1932, when he became president and general manager of the Chicago & Western Indiana and the Belt Railway of Chicago. In August, 1939, he was named executive vice-president of the Lehigh Valley, and in January, 1940, president. He was elected president of the Western Union Telegraph Company in June, 1941, from which position he resigned to join the Westinghouse Air Brake interests.

S. L. Poorman, formerly assistant vice-president of the company, was elected vice-president in charge of sales of Westinghouse Air Brake Company. Mr. Poorman attended Carnegie Institute of Technology and became identified with Westinghouse Air Brake in 1912 as an apprentice in the engineering department. He subsequently was test engineer, mechanical expert and representative of the company in Atlanta, Washington, Boston and New York. He became eastern manager of the company, with headquarters in New York, in 1938 and in 1944 was named assistant to the first vice-president, with offices in Wilmerding. He was appointed assistant vice-president in charge of sales last year.

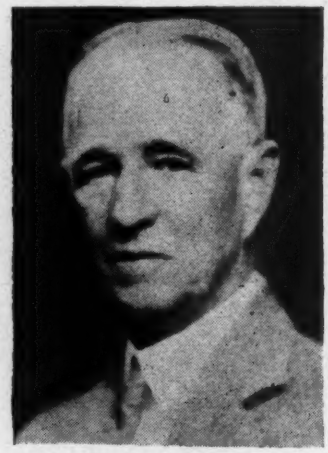
◆

Bullard Company.—*E. C. Bullard,* vice-president and general manager, has been elected president of the Bullard Company to succeed *E. P. Bullard,* who becomes chairman of the board. *George L. Todd,* comptroller, has been elected to a vice-presidency, and *E. P. Bullard, III,* vice-president in charge of manufacturing, has been appointed assistant general manager.

E. C. Bullard

E. C. Bullard is a member of the third generation of the Bullard family and the third to become president of the machine tool plant founded by his grandfather in 1880. He is a graduate of the Sheffield Scientific School of Yale University and served his apprenticeship in the company's shop. Following service in the ordnance department of the Army in the first world war, he returned to work in the foundry, the machine shop, the erecting division and other departments of the Bullard Company until 1930, when he was appointed production manager and elected to the board. He was elected vice-president and general manager in April, 1931.

E. P. Bullard began his apprenticeship under his father in 1892. He was appointed general manager of the plant early in 1902 and elected president in 1907, following the death of his father. He was awarded



E. P. Bullard

the Howard N. Potts gold medal by the Franklin Institute of Pennsylvania in 1920 for his development of the Bullard Mult-Au-Matic and was presented the American Society of Mechanical Engineers medal for his outstanding leadership in the development of station type machine tools in 1927. He served as president of the National Machine Tool Builders Association and pioneered in establishing the trade school system in Connecticut. The trade school in Bridgeport, Conn., for which he raised the original funds and equipment, was renamed in his honor in 1944.

◆

Koppers Company.—*General Brehon B. Somervell,* commander of the Army Service Forces during World War II, has been elected president of the Koppers Company. *J. P. Williams,* who has served as chairman of the board and president since October, 1944, will continue to serve as chairman and chief executive officer.

◆

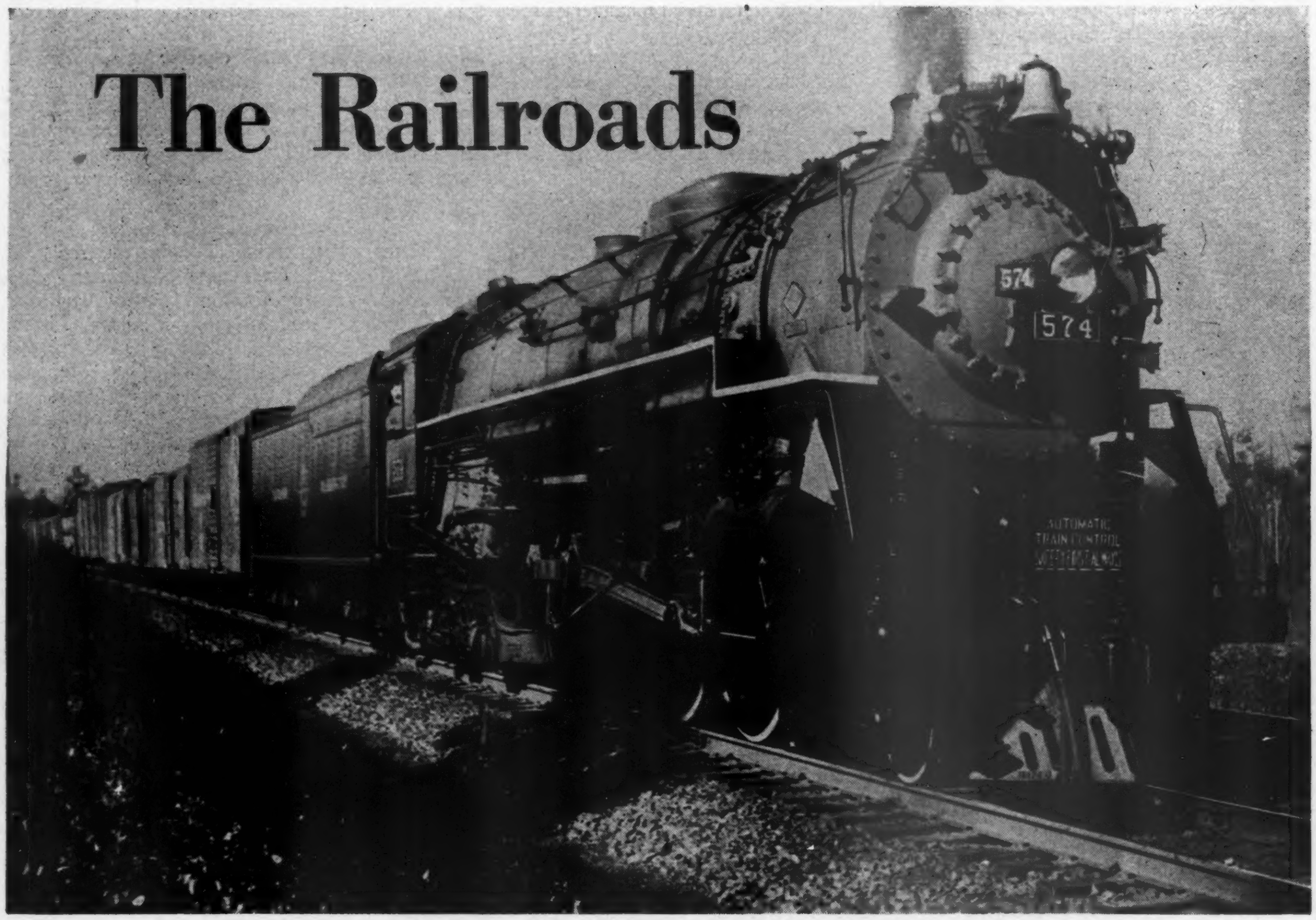
Pittsburgh Steel Foundry Corporation.—Dwight Adams has been appointed head of the Philadelphia, Pa., office of the Pittsburgh Steel Foundry Corporation of Glassport, Pa. Mr. Adams formerly was with the Heppenstall Company of Pittsburgh, Pa.

◆

Spicer Manufacturing Corporation.—*Joseph E. Padgett* has resigned as vice-president of the Spicer Manufacturing Corporation.

◆

Fairbanks, Morse & Co.—Fairbanks, Morse & Co., Chicago, have consolidated



must always look far ahead

Traffic demands must be anticipated for long periods in advance because equipment cannot be built "overnight". So versatile motive power is especially important — locomotives capable of speeding passenger traffic or handling heavy freights with equal facility and economy of operation.

Lima-built modern steam locomotives meet these requirements, and provide the superior performance that results from Lima's insistence upon the highest standards of design, workmanship and materials.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED **INCORPORATED, LIMA, OHIO**

their Diesel Locomotive and Railroad Divisions. *John W. Barriger*, who has been manager of the Diesel Locomotive Division, has been named manager of the recently combined Railroad Division, and *John S. King*, who has been acting manager of the Railroad Division, has been appointed assistant manager of the new division. *V. H. Peterson*, formerly assistant to the president and manager of the New York office of the Baldwin Locomotive Works, has been appointed manager of railroad sales, Eastern division, of Fairbanks-Morse, with offices at 80 Broad street, New York.

◆

AMERICAN CAR AND FOUNDRY COMPANY.—*R. A. Williams*, vice-president of sales, has been elected a director of the American Car and Foundry Company, to succeed W. L. Stancliffe, who recently resigned. Mr. Williams also is executive vice-president and a director of the American Car and Foundry Export Company, having direct supervision of sales, subsidiary companies, and foreign representatives. He has been associated with the sales and engineering staffs of American Car and Foundry since 1924.

R. A. Williams

E. A. Watson, until recently production manager at the Buffalo, N. Y., plant of the American Car and Foundry Company, has been appointed assistant engineer in the company's improvement division, with headquarters in New York.

◆

WAUGH EQUIPMENT COMPANY.—*Robert Watson*, mechanical engineer, western sales manager and assistant to the president of the Waugh Equipment Company, has been elected a vice-president.

◆

APEX RAILWAY PRODUCTS COMPANY.—The Apex Railway Products Company has moved its Chicago office to the McCormick Building, 332 South Michigan avenue.

◆

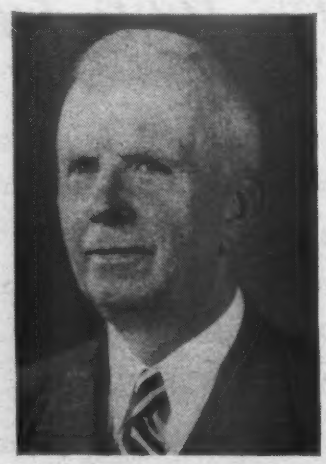
PRESSED STEEL CAR COMPANY.—At the annual meeting of the Pressed Steel Car Company, *H. J. Gearhart* was elected executive vice-president to succeed George H. Fleming; *C. P. Mapp, H. E. Chilcoat* and *G. J. Lindroth* were elected vice-presidents; *B. W. Harvey*, secretary, and *F. D. Evans*, treasurer. *L. J. Lieberthal* was appointed assistant to the president; *S. C. Borland*, assistant secretary, and *C. E. Waldron*, assistant treasurer.

LESLIE COMPANY.—*John S. Leslie*, vice-president and general manager of the Leslie Co., Lyndhurst, N. J., has been elected president to succeed *S. Inglis Leslie*, who becomes chairman of the board.

John Leslie is a graduate of Cornell University with the degree of mechanical engineer, and of the Babson Institute with a degree in business administration. He joined the Leslie organization in 1936; was elected vice-president in 1940, and assigned the additional function and title of general manager in 1943. He is a member of the American Society of Mechanical Engineers and the Society of Naval Engineers, and an associate member of the Society of Naval Architects and Marine Engineers.

John S. Leslie

S. Inglis Leslie started in the pressure regulator business in 1900. He was elected secretary and treasurer of the Leslie Company in 1905 and president in 1926. He is on the board of trustees of the Manufacturers Association of New Jersey.



S. Inglis Leslie

◆

CONTINENTAL OIL COMPANY.—*C. W. Gentry*, traffic clerk, has been appointed assistant manager of railway sales for the Continental Oil Company, with headquarters at Chicago. He succeeds *E. F. Shannon*, who recently was promoted from assistant manager to manager of Continental's railway sales division.

INTERNATIONAL NICKEL COMPANY — The International Nickel Company has announced the opening in Rochester, N. Y., of the Empire State technical section of its development and research division. *Gilbert L. Cox*, metallurgical and chemical engineer, who has been associated with International Nickel since 1931, has been appointed in charge of the new section.

◆

PAXTON-MITCHELL COMPANY; PAXTON DIESEL ENGINEERING COMPANY.—*George T. Badger* has been appointed general sales manager for Paxton-Mitchell Company, Omaha, Neb., and its subsidiary, Paxton Diesel Engineering Company. For the past two years, Mr. Badger has been chief sales engineer for Paxton Diesel Engineering Company. Prior to joining the Paxton companies, Mr. Badger was connected with the Minneapolis-Honeywell Company. Much of his activities with the Paxton companies have been devoted to developing and marketing new products.

George T. Badger

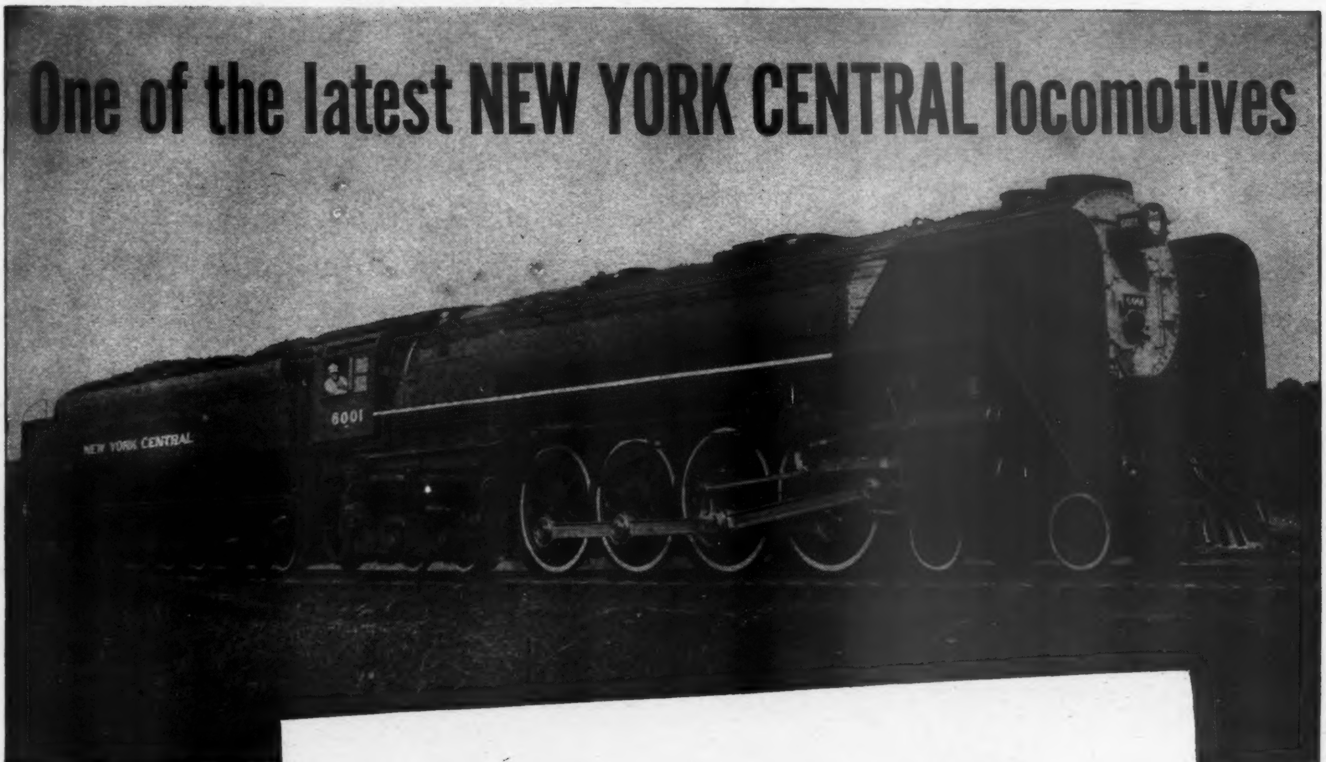
James C. Peugh has been appointed sales and service engineer to cover the western part of the United States for the Paxton-Mitchell Company. Mr. Peugh, who has just returned from 39 months' service with the army, is a graduate of the Kansas State University and was formerly in the employ of the Missouri Pacific. *James J. Keliher*, chief service engineer and assistant to the president of Paxton-Mitchell since 1932, has retired. Mr. Keliher was born in North Platte, Neb., in 1880 and began work with the Union Pacific in that city in 1895. His affiliation with the Paxton-Mitchell Company began in 1910.

Obituary

EDWARD J. FINKBEINER, a vice-president of the American Car and Foundry Company, died March 23.

◆

FRANK PARKER, chairman of the board of Iron & Steel Products, Inc., whose death on March 17 was reported in the April issue, was born at Chicago on January 9, 1890. He attended Armour Institute of Technology, Chicago, devoting eight years to special study in engineering and metallurgical chemistry. He began his business career in 1905, with the Republic Iron & Steel Co. In 1916 he became president of the Railway Car & Equipment Corp. In 1930 Mr. Parker founded Iron & Steel



to have

FRANKLIN SYSTEM of STEAM DISTRIBUTION

The New York Central will soon receive a locomotive equipped with The Franklin System of Steam Distribution, but otherwise the same in construction as its Class S-1b Niagara 4-8-4 shown above.

The new locomotive is designed to be equally efficient for heavy passenger or freight service.

REG. U.S. PAT. OFF.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO • MONTREAL

STEAM DISTRIBUTION SYSTEM • BOOSTER • RADIAL BUFFER • COMPENSATOR AND SNUBBER • POWER REVERSE GEARS
AUTOMATIC FIRE DOORS • DRIVING BOX LUBRICATORS • STEAM GRATE SHAKERS • FLEXIBLE JOINTS • CAR CONNECTION

Products, Inc., and was its president until May, 1943, when he became chairman of the board.

◆

Alfred E. Jones, consultant and service engineer of the general railway department of the Crucible Steel Company of America, died March 24. Mr. Jones was associated with Crucible for 43 years. He formerly was representative in the northeastern part of the United States of the company's railroad department.

◆

L. J. Papineau, vice-president of the Canadian Johns-Manville Company, Ltd., in charge of the transportation department, died April 3. Mr. Papineau was 60 years of age, and had been associated with the firm since 1911.

◆

Bengt E. Folke, mechanical engineer and a director of the Nathan Manufacturing Company, died on March 25. Mr. Folke was born in Sweden in 1903. He was educated at the Polytechnic Institute of

Bengt E. Folke

Orebro, Sweden, and came to the United States in 1922. He was employed with the Great Northern as locomotive shop foreman from 1922 to 1924 and as locomotive designer from 1924 to 1927. He served as assistant mechanical engineer of the Chicago, Indianapolis & Louisville from 1927 to 1933 and was appointed mechanical engineer of the Nathan Manufacturing Company in 1934.

◆

J. Raymond Forney, a railway supply manufacturers' agent with headquarters in Washington, D. C., died on March 24. Mr. Forney was 63 years of age. He was a graduate of Holy Cross College and began his railroad career in the Pittsburgh, Pa., office of the Pennsylvania. For many years he was associated with the Ralston Steel Car Company. He had conducted his own business as a manufacturers' agent since 1925. He was vice-president of the Stoker Parts Company of Pittsburgh, and Washington representative of the Pittsburgh Steel Foundry Corporation. He was the nephew of M. N. Forney, the author of the Catechism of the Locomotive.

Personal Mention

General

Frank K. Mitchell, assistant general superintendent, motive power and rolling stock of the New York Central System, has been appointed general superintendent, motive power and rolling stock, with headquarters as before at New York. Mr. Mitchell was born at Indianapolis, Ind., on November 17, 1894, and is a graduate

Frank K. Mitchell

of Purdue University (B. S. in E. E., 1917, E. E., 1923). After service as a lieutenant in the United States Army overseas during World War I, he entered railway service in December, 1918, as an electrician for the Cleveland, Cincinnati, Chicago & St. Louis. He became draftsman in 1919; service test engineer in 1922; assistant to superintendent motive power in 1923, and master mechanic in 1932. He entered the employ of the Indianapolis Union as a master mechanic in 1936, but returned to the C. C. C. & St. L. in 1938 as assistant superintendent of equipment. In 1940, Mr. Mitchell was appointed assistant general superintendent, motive power and rolling stock of the New York Central, the C. C. C. & St. L., and the Michigan Central, with headquarters at New York, and on April 1, 1946, became general superintendent motive power and rolling stock of the system.

George L. Ernstrom, superintendent of motive power of the Northern Pacific at St. Paul, Minnesota, has been appointed general mechanical superintendent with headquarters at St. Paul. Mr. Ernstrom was born in Norway on May 28, 1886. He entered the service of the Northern Pacific on May 1, 1903, as a locomotive fireman at Duluth, Minn., and later served as engineman and as road foreman of engines at Forsyth, Mont., and Glendive. On May 1, 1926, he was assigned to special duty, conducting tests for the fuel

George L. Ernstrom

department, with headquarters at Livingston, Mont. On May 1, 1928, Mr. Ernstrom was promoted to the position of master mechanic, with headquarters at Staples, Minn., later being transferred to Pasco., Wash., and Missoula. In 1930 he was appointed general master mechanic, with headquarters at St. Paul, and on March 1, 1941, was transferred to Seattle, Wash. On June 16, 1942, he became assistant superintendent of motive power, western district, at Seattle, and in January, 1944, superintendent of motive power at St. Paul.

Leonard C. Kirkhuff, whose appointment as superintendent motive power of the Virginian, with headquarters at Princeton, W. Va., was announced in the April issue, was born on October 3, 1899, at

Leonard C. Kirkhuff

Hutchinson, Kan. He became a machinist apprentice in the employ of the Atchison, Topeka & Santa Fe, at Newton, Kan in 1908. He subsequently served as a machinist and enginehouse foreman at various points, and in 1920 became general locomotive foreman at Chanute, Kan. In 1923, he entered the service of the Kansas City Southern at Pittsburg, Kan., and was successively erecting shop foreman, enginehouse foreman, general foreman, and assistant master mechanic until 1929 when he became division master mechanic at Shreveport, La. Mr. Kirkhuff went with the Virginian as master mechanic at Elmore, W. Va., in May, 1944, and was appointed assistant superintendent motive power,

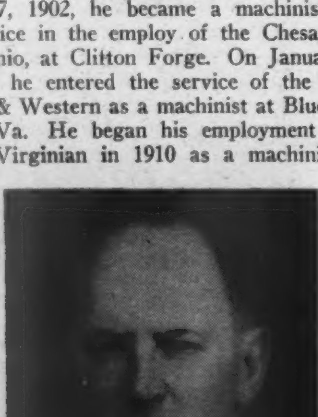
Princeton, W. Va., in May, 1945, and superintendent of motive power on March 1, 1946.

FRANK E. RUSSELL, JR., has been appointed to superintendent of motive power of the Southern Pacific, with headquarters at Sacramento, Calif. Mr. Russell was born at Alameda, Calif., on September 18,

Frank E. Russell, Jr.

1905. He is a graduate of the University of California. He entered railway service in August, 1928, as a special apprentice on the Southern Pacific at Sacramento, subsequently serving as enginehouse foreman, shop foreman and assistant master mechanic at various points. In June, 1941, Mr. Russell was promoted to master mechanic, with headquarters at El Paso, Tex., and one year later became assistant superintendent of motive power at Los Angeles, Calif.

GEORGE T. STRONG, whose retirement as superintendent of motive power of the Virginian at Princeton, W. Va., was announced in the April issue, was born on December 22, 1883, at Clifton Forge, Va. On January 7, 1902, he became a machinist apprentice in the employ of the Chesapeake & Ohio, at Clifton Forge. On January 9, 1906, he entered the service of the Norfolk & Western as a machinist at Bluefield, W. Va. He began his employment with the Virginian in 1910 as a machinist at



George T. Strong

Princeton; in April, 1911, became erecting shop foreman; in August, 1911, machine shop foreman; on April 15, 1915, general erecting shop foreman, and on December 15, 1918, general foreman over a group of shops. Mr. Strong was appointed master mechanic on February 1, 1923, and on April 1, 1930, the office of master mechanic was transferred to Elmore, W. Va. He was appointed general master mechanic at Princeton on June 1, 1936, assistant superintendent motive power on April 20, 1937, and superintendent motive power on June 1, 1938.

F. W. TAYLOR, assistant superintendent of motive power, eastern district, of the Northern Pacific at St. Paul, Minn., has been appointed superintendent of motive power eastern district with headquarters at St. Paul. Mr. Taylor was born at Oakes, N. D., on October 14, 1888. He entered railway service in February, 1905, as an apprentice on the Northern Pacific at Livingston, Mont. He subsequently served as a machinist, night foreman, assistant enginehouse foreman and enginehouse foreman at Livingston until 1931 when he was transferred to Mandan, N. D. Mr. Taylor later was transferred to Missoula, Mont., and Seattle, Wash. In 1934 he was appointed general foreman at St. Paul; in 1940, master mechanic, with headquarters at Glendive, Mont, and in 1944, assistant superintendent of motive power.

E. L. GRIMM has retired as general mechanical superintendent of the Northern Pacific. Mr. Grimm was born at Indianapolis, Ind., on February 9, 1879. He received his higher education in the school of me-

E. L. Grimm

chanical engineering, Purdue University, where he was a graduate in 1901. He entered railway service in 1901 as a special apprentice in the employ of the Chicago Great Western, becoming a machinist in June 1904. Later in 1904 Mr. Grimm became a draftsman of the Northern Pacific at St. Paul. In 1907 he went with the Michigan Central as chief draftsman at Detroit, Mich. Two years later he returned to the Northern Pacific as chief draftsman. In 1916 Mr. Grimm was appointed mechanical valuation engineer; in 1918, mechanical engineer; in 1923, assistant to the general mechanical superintendent; in 1933, assistant to the operating vice-president, and in 1936, general mechanical superintendent.

J. A. CANNON, master mechanic of the Northern Pacific at Spokane, Wash., has been appointed assistant to the general mechanical superintendent at St. Paul, Minn.

A. H. FIEDLER, assistant superintendent of motive power, western district, of the Northern Pacific at Seattle, Wash., has been appointed superintendent of motive power, western district, with headquarters at Seattle. Mr. Fiedler was born at Fargo, N. D., on January 24, 1884. He entered railroad service on June 3, 1903, as a clerk on the Northern Pacific at Fargo. On September 22, 1904, he became a locomotive fireman; three years later locomotive engineer, and on May 1, 1934, road foreman of engines at Jamestown, N. D. He was transferred to Livingston, Mont., on

Arthur H. Fiedler

March 1, 1938. Mr. Fiedler was appointed master mechanic at Jamestown on February 1, 1939; general master mechanic at St. Paul, Minn., on March 1, 1941, and assistant superintendent of motive power at Seattle on January 1, 1944.

H. H. MAGILL has been appointed superintendent, locomotive and car shops, of the Chicago & North Western, with headquarters at Chicago.

WILLIAM L. KINSELL, superintendent of motive power of the Alaska Railroad at Anchorage, Alaska, has been appointed chief mechanical engineer with headquarters at Anchorage.

J. J. PRENDERGAST, mechanical superintendent of the Texas & Pacific at Dallas, Tex., has been granted a leave of absence.

Master Mechanics and Road Foremen

A. G. GEBHARD, master mechanic, Diesel and electric equipment, on the Illinois Central, has been appointed general master mechanic, with headquarters as before at Chicago. The position of master mechanic, Diesel and electric equipment, has been abolished.

RAY G. GIKANEK, who has been appointed master mechanic of the Chicago & North Western at Huron, S. D., as announced in the April issue, was born on July 25, 1905, at St. Paul, Minn. He is a graduate of Mechanic Arts High (1921) and Dunwoody Industrial Institute (1923). He became a messenger in the employ of the Chicago, St. Paul, Minneapolis & Omaha at St. Paul, Minn., in May, 1923; a ma-

chinist apprentice at St. Paul in January, 1924; a machinist at St. Paul in May, 1928, and night enginehouse foreman at St. James, Minn., in September, 1941. He became night general foreman of the Chicago & North Western at Proviso, Ill., in June, 1944, and master mechanic at Huron in August, 1945.

J. S. Fennell has returned to the position of master mechanic of the Philadelphia division of the Reading, after service in the 712th Railroad Battalion. While in the Army Mr. Fennell was promoted from Captain to Major.

F. L. Giekl, acting division master mechanic of the Philadelphia division of the Reading, has been appointed assistant master mechanic, Reading division, with headquarters at the Rutherford enginehouse, Harrisburg, Pa.

N. V. Hendy, master mechanic of the Northern Pacific at Glendive, Mont., has been transferred to the position of master mechanic at Jamestown, N. D.

W. D. Richards has been appointed master mechanic of the Reading division of the Reading.

H. H. Thomas has been appointed master mechanic of the Chicago & North Western, with headquarters at Green Bay, Wis.

W. W. Hoffman, master mechanic of the Chicago & North Western at Green Bay, Wis., has retired.

Murray T. Hughes has been appointed master mechanic of the Alaska Railroad with headquarters at Anchorage, Alaska.

Electrical

Virgil R. Hasty, assistant electrical engineer of the Union Pacific, has been appointed electrical engineer, with headquarters as before at Omaha, Neb.

George M. Brown has been appointed electronics engineer of the New York Central, with headquarters at New York. Mr. Brown was born on December 16, 1908, at Outlook, Wash., and is a graduate

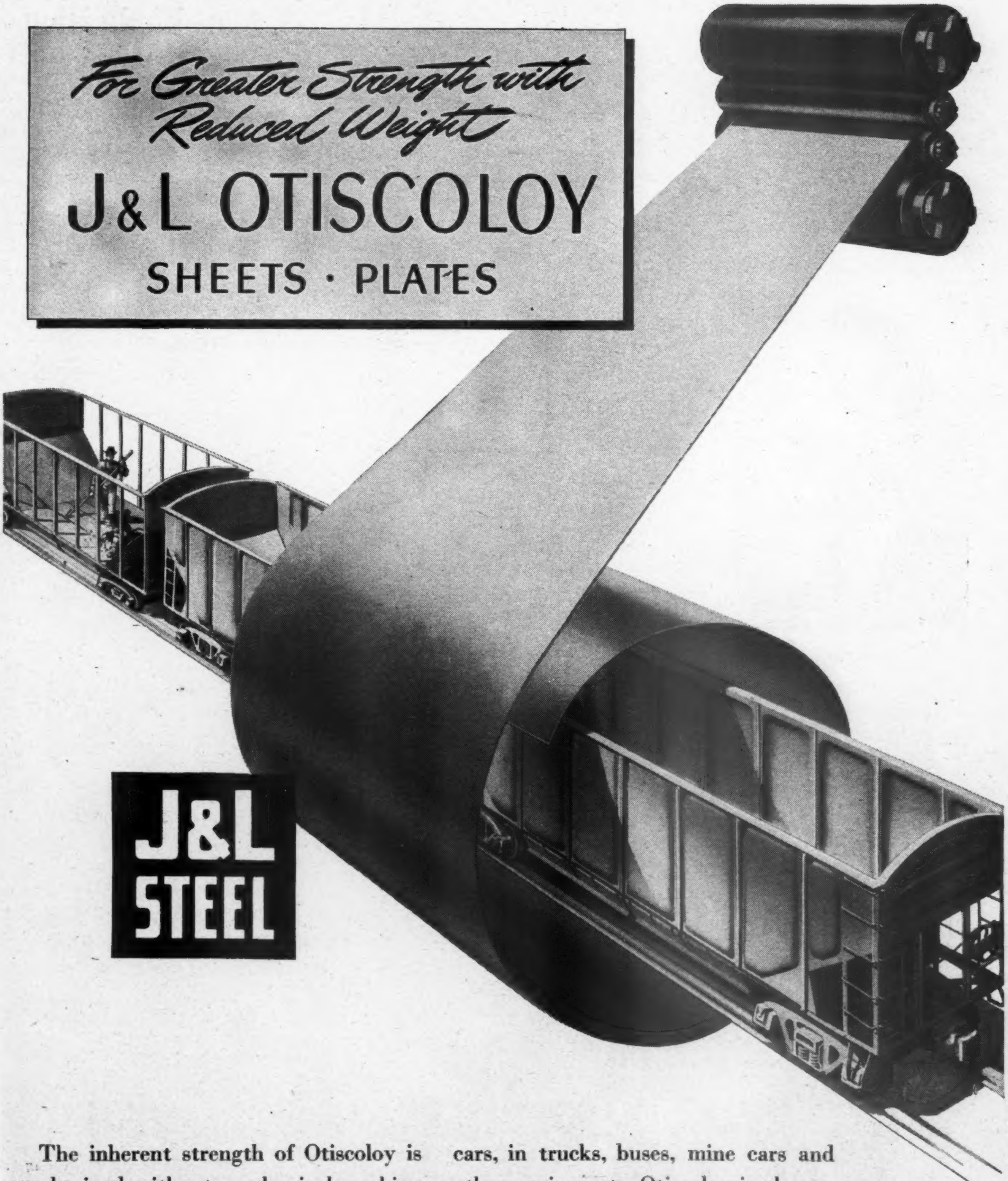
George M. Brown

of Washington State College (B. S., electrical engineering, 1929). He entered the employ of the General Electric Company in July, 1929, in the radio engineering department, later called transmitter division

For Greater Strength with Reduced Weight

J&L OTISCOLOY

SHEETS · PLATES



The inherent strength of Otiscoloy is obtained without mechanical working or heat treating, which gives it exceptional weldability and formability for a high-tensile steel. It is being used successfully to reduce dead-weight and increase pay load in railroad freight cars, in trucks, buses, mine cars and other equipment. Otiscoloy is also resistant to abrasion and corrosion. Our metallurgical engineers will be glad to discuss the application of Otiscoloy to your production problems. Write for further information.

JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH 30, PA.

of electronics department. He later became section leader, with engineering responsibility for emergency equipment. Mr. Brown joined the New York Central on January 1, 1946.

Car Department

James P. Cargill, whose appointment as superintendent of the Hayne car shop of the Southern at Spartanburg, S. C., was announced in the February issue, was born on November 4, 1895, at Hartwell,

James P. Cargill

Ga. He entered railroading in 1919 as a machinist in the employ of the Southern at the Hayne enginehouse at Spartanburg. He became assistant foreman of the enginehouse at Columbia, S. C., in 1922; foreman of the enginehouse at Hayne in 1923; general foreman at Hayne in 1924, and general foreman at Asheville, N. C., in 1928. Mr. Cargill was appointed master mechanic in 1934, and served at Lawrenceville, Va., Richmond, and Columbia, S. C., successively until 1944, when he was named assistant master mechanic at Spencer, N. C. He was appointed superintendent Hayne car shop on January 1.

Shop and Enginehouse

H. A. Grange has been appointed assistant superintendent, locomotive shops, of the Chicago & North Western, with headquarters at Chicago.

Obituary

N. V. Moore, superintendent Hayne car shop of the Southern died on December 6. Mr. Moore was born on October 2, 1904, at Knoxville, Tenn. He began his railway career at Knoxville in 1923 as a machinist in the employ of the Southern at Coster shop, later transferring to the Hayne car shop at Spartanburg, S. C. He became, successively, machinist supervisor, Columbia, S. C., in 1937, assistant foreman enginehouse at Columbia in 1939, and general foreman, Spencer, N. C., in 1942. Mr. Moore was appointed superintendent, roadway shop at Charlotte, N. C., in 1942, and later became superintendent of the Hayne car shop at Spartanburg, S. C.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

"Selectrode Chart."—Hollup Corporation, 4700 West Nineteenth street, Chicago. Chart aids in the selection of an electrode for a specific job, suggests applications, shows currents, positions, physical characteristics, etc. Included are electrodes recommended for mild, low-alloy and stainless steels; non-ferrous and cast iron; surfacing, as well as gas welding rods.

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Planers.—Rockford Machine Tool Co., Rockford, Ill. Fourteen-page, wire-bound Bulletin 190 describes and illustrates the design, construction, and operation of the Rockford Hy-Draulic openside planer. Gives detailed specifications for all of the four rated sizes.

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Gas Atmospheres.—Surface Combustion Corporation, Toledo 1, Ohio. Twelve-page illustrated booklet (SC-129) of information on the preparation and applications of various types of atmospheres used in the heat processing of metals. Discusses also the nature of the constituents of the various atmospheres, the effect of each, and the combinations used.

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Soft Hammers. — Gregory Tool and Manufacturing Co., 5300 Tireman avenue, Detroit 4, Mich. Six-page catalog giving specifications of "Perfect Balance" line of soft hammers ranging in head diameter from ¾ in. to 2½ in. and in weight from 3 oz. to 10½ lb. for industrial, commercial and professional purposes.

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Stainless-Steel Bellows. — Chicago Metal Hose Corporation, Maywood, Ill. Twelve-page booklet, No. SSB-46, entitled "C. M. H. Stainless Steel Bellows," contains diagrammatical cross-section views and information concerning the use of stainless-steel bellows as equalizers, compensators, expansion joints, flexible connectors, for flow control, vapor and steam traps, thermostatic instruments, electrical controls and many other industrial applications.

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Hardex Electrodes.—Metal & Thermit Corporation, 120 Broadway, New York 5. Sixteen-page booklet on hard surfacing and the use of Hardex arc-welding electrodes in building up surfaces for resistance to shock and abrasion. Gives information on the effect of temperature and cooling rates on deposited metal, selection of the proper grade of rod, and recommended welding techniques.

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"Air Foam." — Pyrene Manufacturing Company, 560 Belmont avenue, Newark 8, N. J. Illustrated booklet describes the newer mechanical or air foam formed without chemical reaction, for fire fighting. Tells how air foam is produced either by portable playpipes or stationary foam makers.